The Welding Engineer

Founded by L. B. Mackenzie, 1916

APRIL, 1926 VOL. 11, No. 4

$3.00 per year in U. S. 606 S. Dearborn St., Chicago, Ill. Reg. U. S. Pat. Office $4.00 per year abroad

3 REASONS FOR ORDERING

THE MANN MASTER CONTROLLER
for
Electric Arc Welders

10 REASONS FOR KEEPING

The welder—"The MANN MASTER CONTROLLER is the best helper I ever had with me on a job."

You may order subject to cancellation within thirty days after test.

Price — $190.00 f.o.b. Pittsburgh, Pa.

FIRST
Produces stronger non-porous welds. Eliminates pores, pinholes and gas pockets.

SECOND
Makes overhead, corner and gap welding easy. Welds as low as ten amperes for thin metals.

THIRD
Saves time, money, wire and speeds production. Prevents leaks and increases current capacity.

ELECTRIC WELDER CONTROLLER COMPANY
602 BIGELOW BOULEVARD, PITTSBURGH, PENNSYLVANIA

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill. Under the Act of March 3, 1879.

Don't page the junk man!

THESE FACTS are true, not only of Oxweld blowpipes, but of the well-known Oxweld low pressure acetylene generator. Many thousands of installations in nationally known plants are giving service of such satisfactory character that not only because of the high trade-in value customers replace them, when finally necessary, with new ones made by Oxweld.

YOU won't need to if you buy Oxweld apparatus.

When you trade-in your automobile you prepare for the worst and you get even less. The same thing holds good for the trade-in value of a lot of industrial equipment.

Oxweld blowpipes, on the other hand, have a high trade-in value. Add to this the fact that Oxweld apparatus has a long industrial life and stands up under severe daily service, and you have a combination that spells economy.

These are just two more reasons for Oxweld's leadership.

OXWELD ACETYLENE COMPANY

Chicago	Long Island City, N.Y.	San Francisco
3642 Jasper Place	Thompson Ave. & Orton St.	1050 Mission Street

Oxweld

WELDING AND CUTTING APPARATUS

Your Assurance of High Cutting Efficiency Stamped on Every Airco Oxygen Cylinder

What does this stamp mean To You?

CONTENTS AIRCO OXYGEN 99.5% PURE

"A saving of 10% in time and material may safely be accepted as correct for any increase of 0.5% in the quality of oxygen of which the minimum purity is 98.5%."– *From an Editorial in Industrial Gases.*

AIRCO OXYGEN IS 99.5% PURE IN THE CYLINDER

OXYGEN
NITROGEN
NEON

AIRCO

ACETYLENE
CALORENE
CARBIDE

AIRCO - DAVIS - BOURNONVILLE OXYACETYLENE APPARATUS

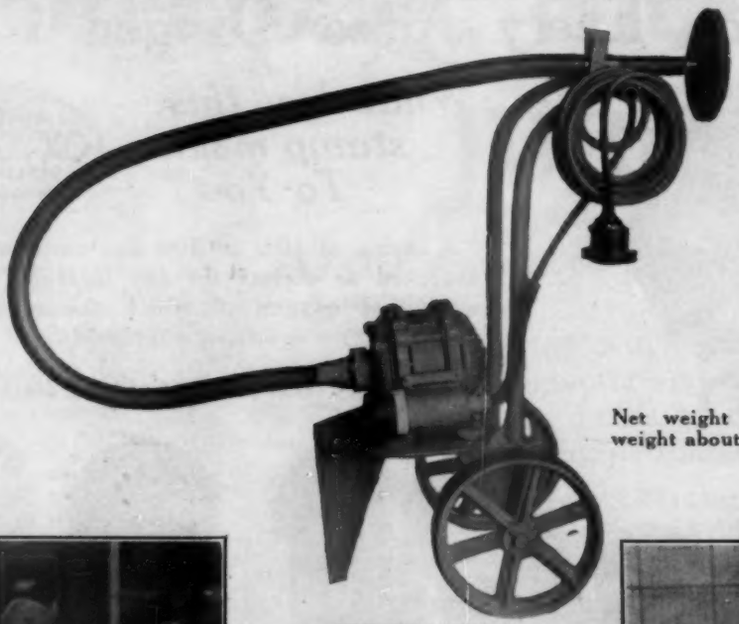
51 AIRCO PLANTS
17 DISTRICT OFFICES

AIR REDUCTION SALES CO.

342 MADISON AVENUE
NEW YORK CITY, N. Y.

Guaranteed to stand the gaff

High Speed **Heavy Duty**



Net weight 155 lbs. Shipping weight about 200 lbs.

SPECIFICATIONS

3 Phase Alternating Current 220 or 440 volt

Speed

50 cycle—3000 r.p.m.
60 cycle—3600 r.p.m.

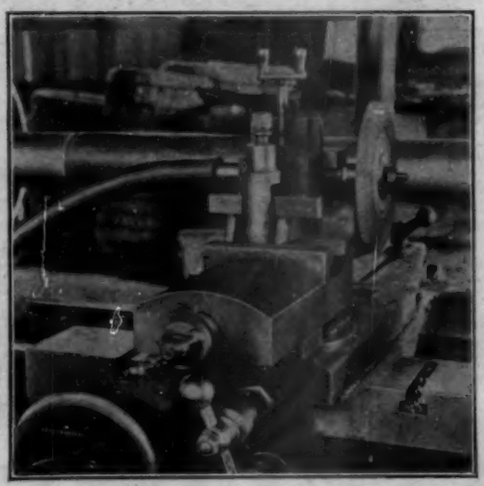
1 H. P. Auto Start, Heavy duty, Ball Bearing Motor. Bearings completely enclosed. Heavy insulated winding, with specially constructed rotor that expels all foreign matter.

7 ft. Flexible Shaft with Double Housing

Equipment includes Grinding Wheel, 25-ft. 3 conductor Super-Service Cable with Heavy Polarity Plug and Cap. Complete, mounted on substantial steel frame truck as illustrated.

Built For Grinding in Places That Have Heretofore Been Considered Inaccessible

The hand spindle is 1⅜ in. in diameter, so that when it is necessary the wheel can be removed, the handle inserted thru a hole of 1⅜ in. diameter or larger and the wheel put on, so that by pulling back on the hand spindle grinding can be done in almost inaccessible places. The design of the machine is such that it is readily applicable for many unusual grinding operations. The large 2 in. x 12 in. truck wheels permit easy moving and the stiff leg in front prevents the machine from moving when on sloping or uneven floors.



Spindle Can Easily Be Held In Tool Post Of Lathe Or Shaper For External Or Internal Grinding Or Surfacing Of Flat Work.

Built For Heavy Continuous Grinding —Polishing—Buffing Service

The large powerful motor is built for heavy work, and will not heat up if used continuously, yet the shaft and wheel that the operator necessarily has to hold is so light that articles can be ground to the exact size, as the operator can touch the wheel to the work as lightly or as heavily as he pleases. Owing to its lightness and lack of vibration a wheel of 1-16 in. thickness can successfully be used. For heavy work a 1 in. x 8 in. wheel, which will have a surface speed of about 1¼ miles per minute, will hog the metal off as fast as desired.

Manufactured and Sold by

WHITTIER **Stoody Company** CALIFORNIA

The Welding Engineer

Founded by L. B. Mackenzie, 1916 — Reg. U. S. Pat. Office

Volume 11 — April, 1926 — Number 4

Editorial 17

All Welded Pipe Railings 19

Deposit Efficiency of Electrodes 21
By. J. B. Green

"Stelliting," a Special Process 25

Oxy-Acetylene Welding of Copper 29
By S. W. Miller*

Atomic Hydrogen Arc Welding 31

Welding Wire Specifications 33
By H. E. Burk*

Buying a Spot Welder 34

Spring Meeting of the American Welding Society 20

J. C. Lincoln Talks to Chicago Boiler-Makers 24

The Mann Master Controller 28

Film Shows Structural Steel Welding 30

McCune Talks to Chicago Section 35

News of the Welding Trade 36

Current Welding Literature 36

No Job for a Lazy Man

ALTHOUGH a well planned advertising campaign usually operates to reduce the selling cost of the article advertised, the man behind it is not taking the easiest way to make sales. A successful campaign is invariably the product of hard study and thought. But the important thing to the customer is that when the manufacturer has built a reputation for himself by advertising he feels the necessity of making his product live up to that reputation. Maintaining quality then becomes an all-important subject, for a national authority on advertising states that this great economic force will build a favorable reputation only for products that deserve it, and will hasten the decline of less deserving goods. The men who are offering their merchandising to you through your business paper are on the alert to see that the quality of their goods measures up to their claims, and the employees in their factories, proud of the distinction which their handiwork receives, are watching every detail which helps them earn their reputation as skilled craftsmen. These things have done more to improve the quality of merchandise that any other influence.

Published on the 15th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,

601 S. Dearborn St., Chicago, Ill.

Telephone Wabash 7134

G. H. Mackenzie ..... President and Treasurer
M. J. Hungerford ..... Vice-President
H. S. Card ..... Secretary

H. S. Card ..... Managing Editor
W. W. Brothers ..... Editor
A. F. Mac Coll ..... Field Representative

Eastern Office—222 American Circle Bldg., New York
T. E. DePew, Eastern Manager
Telephone, Columbus 6941

Subscription payable in advance and postage free.
United States and possessions and Canada ..... $3 a year
Foreign Countries ..... $4 a year
Single copy, domestic ..... 25 cents
Single copy, foreign ..... 30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives

CLEVELAND—R. K. Randall, 2200 Prospect Ave.

GREAT BRITAIN—Capt. D. Richardson, 20 Red Lion Square, Holborn, London, W. C. I.

AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.

SOUTH AFRICA—J. W. Arnison, 25a Victoria Ave., Benoni, Transvaal, South Africa.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.
Purox Co.

ACETYLENE CYLINDERS
Keith Dunham Company

AIR LIQUEFACTION OXYGEN PRODUCING PLANTS
Keith Dunham Company
Heylandt Sales Co.

ALUMINO-THERMIC WELDING
Alumino-Thermic Corporation

ANNEALING FURNACES
General Electric Co.
Westinghouse Elec. & Mfg. Co.

APRONS (Asbestos)
Ideal Face Shield Co.
Safety Equipment Service Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

BOOKS
The Welding Engineer Pub. Co.
Electric Arc Cutting & Welding Co.

BRAZING OUTFITS
Air Reduction Sales Co.
Carbic Mfg. Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
United States Welding Co.

BRONZE FILLER RODS
American Brass Co.
Central Steel & Wire Co.
Steel Sales Corp.

BUFFERS
N. A. Strand & Co.
Wodack Electric Tool Corp.

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
C. H. Hollup Corp.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.

CARBIDE
Air Reduction Sales Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBIDE (Compressed in Cakes)
Carbic Mfg. Co.

CARBON (Blocks, Paste, Electrodes, etc.)
Air Reduction Sales Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.
U. S. Welding Co.

CARBON BURNING EQUIPMENT
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
U. S. Welding Co.

CONSULTING ENGINEER
E. F. Hollinger

CONTROLLERS (For Arc Welders)
Electric Welder Controller Co.

CUTTING ELECTRODES (Electric Arc)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
National Carbon Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company

CYLINDERS (Oxygen, Hydrogen)
Wm. Wharton, Jr. Co.

DRILLS, PORTABLE ELECTRIC
N. A. Strand & Co.
Wodack Electric Tool Corp.
Stoody Company

ELECTRIC ARC WELDING OUTFITS
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Goodman Electric Machinery Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
H. E. Steinbock
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

ELECTRODES (Carbon Arc Welding)
See "Cutting Electrodes"

ELECTRODES (Metallic Arc Welding)
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Indianapolis Switch and Frog Co.
Koro Electric Co.
Lincoln Electric Co.
Page Steel & Wire Co.
H. E. Steinbock
Reid-Avery Co.
Roebling, John A., Sons Co.
Steel Sales Corp.
Seneca Wire & Mfg. Co.
Stoody Co.
Stulz-Sickles Co.
Una Welding and Bonding Co.
Welding Materials Co.
Welding Service Co.
Wickwire-Spencer
Wilson Welder & Metals Co.

ELECTRODE HOLDERS
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
C. H. Hollup Corp.
Indianapolis Switch and Frog Co.
Koro Electric Co.
Lincoln Electric Co.
H. E. Steinbock
Stoody Co.
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

ELECTRODE TIPS (Resistance Welding)
Elkon Works, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
Allan Mfg. Co. & Welding Co.
American Optical Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Safety Equipment Service Co.
H. E. Steinbock
Strauss & Buegeleisen
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.
Wilson Goggles, Inc.

FILLER RODS
Air Reduction Sales Co.
American Brass Co.
Central Steel & Wire Co.
Oxweld Acetylene Co.
C. H. Hollup Corp.
Page Steel & Wire Co.
Purox Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Steel Sales Corp.
Seneca Wire & Mfg. Co.
Stoody Co.
Stulz-Sickles Co.
Torchweld Equipment Co.
Wickwire-Spencer

FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.
U. S. Welding Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Bastian-Blessing Co.
Griesheim
Hoxite Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Oxweld Acetylene Co.
Phillips-Laffitte Co.
Torchweld Equipment Co.

GLOVES (Asbestos)
Ideal Face Shield Co.
Safety Equipment Service Co.

GAUGES
National Gauge & Equipment Co.
U. S. Gauge Co.

GENERATORS (Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
M. Keith Dunham
Griesheim
Imperial Brass Mfg. Co.
Milburn, Alexander Co.
Oxweld Acetylene Co.
U. S. Welding Co.

GOGGLES
American Optical Co.
Ideal Face Shield Co.
Safety Equipment Service Co.
Strauss & Buegeleisen
Willson Goggles, Inc.

GRAPHITE (Rods, Blocks, Paste, Etc.)
Joseph Dixon Crucible Co.

GRINDERS (Portable Electric)
N. A. Strand & Co.
Wodack Electric Tool Corp.
Stoody Company

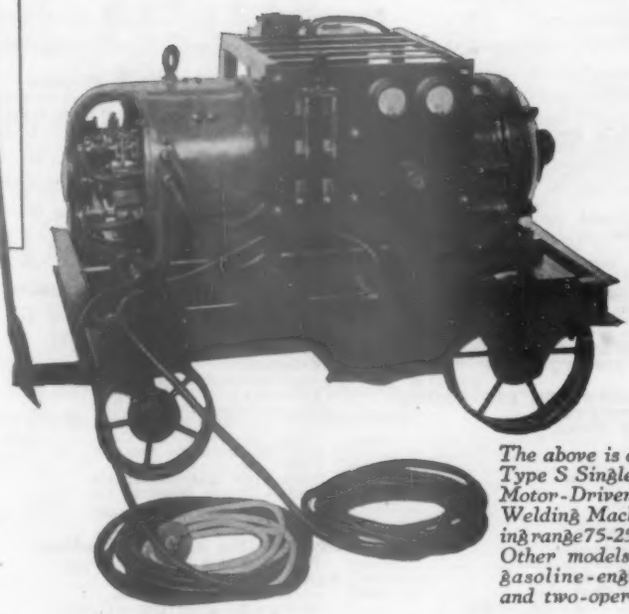
HELMETS (Arc Welding)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Safety Equipment Service Co.
H. E. Steinbock
Strauss & Buegeleisen
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

HYDROGEN
Gas Products Association
International Oxygen Co.

HYDROGEN GENERATING PLANTS
International Oxygen Co.

LEAD WELDING UNITS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
U. S. Welding Co.

"I'll Tell You Why I Like Wilson Wire— It's Always Uniform"



The above is a Wilson Type S Single-Operator Motor-Driven Electric Welding Machine, welding range 75-250 amperes. Other models include gasoline-engine-driven and two-operator units.

Simplicity—Close Control—Ruggedness

Welders like Wilson Wire because they *know* they can depend on its uniformity—they know it's *always the same*—that every rod is like every other rod of the same grade (analysis). And they know they can secure just the right grade for every type of welding job—each grade designated by a color. There is no saving in using inferior wire just because it's cheap. Use Wilson. Write today for samples of Wilson "Color-tipt" Welding Wire, indicating the metal you desire to weld.

Unexcelled simplicity, close regulation, strength and ruggedness of every part—*better engineering throughout*—these are what make the Wilson Type S a *better welding machine.* Its features include a *self-exciting* generator; a commutator that always shows *less temperature rise than any other part of the machine;* an arc that is easy to strike and easy to maintain; a simple, compact control panel; a current adjustment by a simple turning of a field rheostat knob; a special resistance unit which can be supplied *for reducing the welding current to as low as 25 amperes* for light work and thin gauge metals. These and other features—many of which are found in no other machine—make the Wilson Type S the decided choice for practically every kind of welding.

The Wilson company devotes itself exclusively to the development and production of welding equipment and supplies. Its unusual experience in all classes of electric welding is available for the solution of your welding problems.

WILSON WELDER & METALS CO. INC., WILSON BLDG., HOBOKEN, NEW JERSEY

WILSON

WELDING MACHINES AND WELDING WIRE

LIGHTERS (For Gas Torches)
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
U. S. Welding Co.

MANIFOLDS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Griesheim
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
U. S. Welding Co.

MECHANICALLY OPERATED CUTTING AND WELDING TORCHES
Air Reduction Sales Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

MOLDING MATERIAL
See "Fire Proof Plastic Material"

MONEL METAL RODS AND ELECTRODE
Central Steel & Wire Co.
Wilson Welder & Metals Co.

NEEDLE VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Griesheim
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
United States Welding Co.

SCHOOLS (Correspondence)
Kerr's Welding School

STAMPS (For Marking Cylinders)
Collins Stamp Mfg. Co.

TANK CONNECTIONS
Air Reduction Sales Co.
Bastian-Blessing Co.

NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

OXYGEN
Air Reduction Sales Co.
Gas Products Association
International Oxygen Co.
Linde Air Products Co.
Purox Co.

OXYGEN PRODUCTION PLANTS
Keith Dunham Company

PREHEATING DEVICES AND OVENS
Bastian-Blessing Co.
Metal & Thermit Corp.

RAIL BONDS
Una Welding and Bonding Co.

RAIL JOINT WELDERS
Indianapolis Switch and Frog Co.
Una Welding and Bonding Co.

REAMERS (Portable Electric)
N. A. Strand & Co.
Wodack Electric Tool Corp.

REGULATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
G. & G. Brass Mfg. Co.
Griesheim
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
United States Welding Co.

SCHOOLS (Correspondence)
Kerr's Welding School

STAMPS (For Marking Cylinders)
Collins Stamp Mfg. Co.

TANK CONNECTIONS
Air Reduction Sales Co.
Bastian-Blessing Co.
Torchweld Equipment Co.
United States Welding Co.

NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

OXYGEN
Air Reduction Sales Co.
Gas Products Association
International Oxygen Co.
Linde Air Products Co.
Purox Co.

OXYGEN PRODUCTION PLANTS
Keith Dunham Company

PREHEATING DEVICES AND OVENS
Bastian-Blessing Co.
Metal & Thermit Corp.

RAIL BONDS
Una Welding and Bonding Co.

RAIL JOINT WELDERS
Indianapolis Switch and Frog Co.
Una Welding and Bonding Co.

REAMERS (Portable Electric)
N. A. Strand & Co.
Wodack Electric Tool Corp.

REGULATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
G. & G. Brass Mfg. Co.
Griesheim
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
United States Welding Co.

THERMIT WELDING
Metal & Thermit Corp.

TORCHES (Welding and Cutting)
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Griesheim
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.
Welding Service Co.
United States Welding Co.

TRUCKS (Cylinder)
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Welding Service Co.
Torchweld Equipment Co.

VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
International Oxygen Co.

WELDING COMPOUND (for Shape Welding)
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.
U. S. Welding Co.

WELDING ROD HOLDERS
Stoody Co.
C. Sorensen

WELDING RODS AND WIRE
See "Electrodes" and "Filler Rods"

There's No Waste Motion Here

YOU can undoubtedly reach a large number of good firms through an advertising campaign which is concentrated in papers reaching selected industries, and reach along with them thousands of readers who are not and never will be concerned with welding—that's waste. You pay a needlessly high price for the interest that's there, and you make a decidedly less effective impression on that interest than if you used a less expensive campaign in **The Welding Engineer**, which reaches the concentrated interest of the country. In these pages you talk to the **right man**, in the **right plant**, at the **right time**. That's efficiency.

Ask for a copy of "The Welding Industry"

The Welding Engineer 608 S. Dearborn St., Chicago

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Company..... 3
Allan Mfg. and Welding Co..... 48
The American Brass Co..... 37
American Welding Society..... 49
American Optical Co..... 41

C

Central Steel & Wire Co..... 42
Chicago Eye Shield Co..... 47
Chicago Steel & Wire Co..... 46
Collins Stamp Mfg. Co.....
Commercial Acetylene Supply Co..... 49
Alfred E. Corp..... 50

D

Joseph Dixon Crucible Co..... 45
Keith Dunham Company..... 44

E

Elec. Arc Welding & Cutting Co..Back Cover
Electric Controller Co.....Front Cover
Elkon Works, Inc.....Inside Back Cover
Edwards Mfg. Co.....

F

Fibre-Metal Products Co.....

G

G. & G. Brass Mfg. Co.....
Gas Products Assn..... 8
General Electric Co..... 11
Griesheimer 41
Goodman Electric Mach. Co..... 50

H

Harris Calorific Co..... 43
Heylandt Sales Co..... 50
E. F. Hollinger..... 47
C. H. Hollup..... 47
Hoxite Co. .....

I

Imperial Brass Mfg. Co..... 49
Ideal Face Shield Co..... 47
Indianapolis Switch & Frog Co..... 13
International Oxygen Co..... 50

K

Kerr's Welding School..... 39
K-G Welding & Cutting Co..... 41
Koro Electric Co..... 41

L

Lincoln Electric Co..... 14
Linde Air Products Co..... 18

M

Metal and Thermit Corp.....
Milburn, Alexander, Co..... 41

N

National Carbon Co..... 51
National Gauge and Equipment Co.....

O

Oxweld Acetylene Co..... 1

P

Page Steel & Wire Co..... 40
Phillips-Laffitte Co. 42
The Prest-O-Lite Co., Inc..... 16

R

Reid-Avery Co..... 38
Roebling, John A., Sons Co..... 42

S

Safety Equipment Service Co..... 43
Seneca Wire Mfg. Co..... 47
C. Sorenson 50
Shawinigan Products Corporation..... 49
H. E. Steinbock..... 50
Steel Sales Corp..... 15
Stoody Co..... 4
Straus & Beugeleisen..... 49
N. A. Strand & Co..... 50
Stulz-Sickles Co. 46

T

Torchweld Equipment Co..... 48

U

Una Welding & Bonding Co..... 45
Union Carbide Sales Co..... 9
U. S. Gauge Co..... 50
U. S. Light & Heat Corp..... 50
United States Welding Co.....

W

Welding Materials Co..... 43
Welding Service Co.....
Westinghouse Electric Mfg. Co.....
William Wharton, Jr. & Co., Inc..... 42
Wilson Welder & Metals Co..... 7
Wickwire-Spencer 44
Willson Goggles, Inc..... 46
Wodack Electric Tool Corporation..... 39

UNION CARBIDE

WORLD'S BEST QUALITY—HIGHEST GAS YIELD

ALWAYS PACKED IN BLUE AND GRAY DRUMS

Large Stocks of Union Carbide in all regular commercial sizes are carried at each of Union Carbide Sales Company's Warehouses listed below.

Requests for information and special correspondence should be addressed to our New York, Chicago or San Francisco offices.

Generator Sizes of Union Carbide

Packed in 100 Pound Drums

3½ in. x 2 in. (Lump)
2 in. x ½ in. (Egg)
1¼ in. x ⅜ in. (Nut)
¼ in. x 1/12 in. (Quarter)

For Oxy-Acetylene Welding and Cutting Plants, Acetylene House Lighting and Cooking Plants, Contractor's Torches and Flare Lights, and numerous other pieces of Acetylene generating apparatus designed for the use of one of these sizes of Carbide.

UNION CARBIDE SALES COMPANY

Peoples Gas Building
Chicago, Ill.

Carbide and Carbon Building
30 East 42nd St.
New York

Balfour Building
California and Sansome Sts.
San Francisco, Calif.

UNION CARBIDE SALES COMPANY'S WAREHOUSES

Shipments Always Made On Day Orders Are Received

ALABAMA
Birmingham....2329 First Ave. N.
Mobile....16 S. Commerce St.
Montgomery....N. Lawrence & Randolph Sts.

ARIZONA
Phoenix....42 S. Central Ave.

ARKANSAS
Ft. Smith....201 Rogers Ave.
Little Rock....1400 E. 6th St.

CALIFORNIA
Fresno....902 H St.
Los Angeles....639 Gibbon St.
Oakland....See San Francisco
Sacramento....1717 Third St.
San Diego....301 Fourth St.
San Francisco....Balfour Bldg., 351 California St.
Stockton....743 S. Union St.
Taft....130 Center St.

COLORADO
Denver....Nineteenth and Wazee Sts.

CONNECTICUT
East Hartford....325 Prospect Ave.

DISTRICT OF COLUMBIA
Washington....New York and Florida Aves., N. E.

FLORIDA
Jacksonville....P. O. Box 473, 1008 E. Bay St.
Miami, P. O. Box 390, 113 N. W. Twenty-third St.
Tampa..P. O. Box 1303, Ellame Ave. and 13th St.

GEORGIA
Atlanta....Haynes & Rhodes St., P. O. Box 1594
Savannah....725 Wheaton St.

ILLINOIS
Chicago....122 S. Michigan Blvd.
Danville....511 Oak St.
Decatur....133 W. William St.
East St. Louis....700 Broadway
Eldorado....856 S. Fourth St.
Harrisburg....Jackson and Raymond Aves.
Marion....315 S. Granite St., P. O. Box 747
Monmouth....509 S. First St.
Peoria....100-110 Edmund St.
Quincy....313 Delaware St.
Springfield....1000 E. Monroe St.
Streator....501 E. Hickory St.

INDIANA
Evansville....1401 E. Illinois St.
Fort Wayne....2206 Broadway
Indianapolis....330 W. New York St.
Terre Haute....541 N. Fifth St.

IOWA
Davenport....118 Harrison St.
Des Moines....Third and Elm Sts.
Dubuque....Eighth and Washington Sts.
Fort Dodge....Central Ave. at Sixteenth St.
Ottumwa....207 S. Washington St.
Sioux City....410 Court St., P. O. Box 398
Waterloo....1209 E. Fourth St.

KANSAS
Pittsburg....1201 North Broadway
Salina....154 N. Fifth St.
Wichita....600 W. Douglas Ave., P. O. Box 951

KENTUCKY
Allen....
Central City....306 Broad St.
Lexington....Third and Walton Ave.
Louisville....Jackson St. and River Rd.
Middlesboro....1701 Cumberland Ave.

LOUISIANA
Monroe....219 Walnut St., P. O. Box 1280
New Orleans....118 N. Front St.
Shreveport....615 Market St., P. O. Box 62

MAINE
Portland....48 Commercial St.

MARYLAND
Baltimore....19 E. Lombard St.
Cumberland....P. O. Box 172, 18 N. George St.
Salisbury....Mill and High Sts.

MASSACHUSETTS
Cambridge....539 Concord Ave.
Indian Orchard....Pasco Road
Worcester....342 Canterbury St.

MICHIGAN
Detroit....5785 Hamilton Ave.
Grand Rapids....425-459 Ionia Ave., S. W.
Iron Mountain....513 Stephenson Ave.
Iron River....321 Carnegie Ave., P. O. Box 357
Ironwood....232 E. Ayer St.
Ishpeming....511 E. Vine St.
Jackson....518 S. Water St.
Lansing....617 E. Shiawasee St.
Muskegon....301 W. Western Ave.
Saginaw....1830-1840 N. Michigan Ave.
Sault Ste. Marie....

MINNESOTA
Minneapolis....334 N. First St.
Virginia....413 Chestnut St.

MISSISSIPPI
Vicksburg....1701-03 Levee St., P. O. Box 322

MISSOURI
Kansas City....1422 St. Louis Ave.
St. Joseph....920 S. Sixth St.
St. Louis....(See East St. Louis, Ill.)

MONTANA
Great Falls....420 Second St. S.

NEBRASKA
Omaha....1007-9-11 Jones St.

NEW JERSEY
Camden....Front and Division Sts.
Newark....251-55 Ridgewood Ave.

NEW YORK
Albany....103 Third Ave.
Binghamton....85 Prospect Ave.
Buffalo....1345 Genesee St.
Garden City....Near Clinton Rd. Sts.
Geneva....261 Exchange St.
Kingston....O'Neil St., Near Broadway
Niagara Falls....
Poughkeepsie....Smith St. and C. N. E. R. R.
Syracuse....376 W. Water St.
Utica....135 Hotel St.
Watertown....438 Court St.
Whitehall....35 Main St.

NORTH CAROLINA
Charlotte....205 W. First St., P. O. Box 777
Raleigh, McCullough and Lenoir Sts., P. O. Box 149
Wilmington....612 Surry St.
Wilson....700 S. Goldsboro St.

NORTH DAKOTA
Fargo....Fifth St. and Second Ave., N.

OHIO
Akron....97 East South St.
Athens....Corner Factory and Moore Sts.

Canton....618 Mulberry Road, S. E.
Cincinnati....67 Plum St.
Cleveland....1348 Hanna Bldg.
Columbus....330 Dublin Ave.
Dayton....104-114 S. Wayne Ave.
Gallipolis....700 First Ave.
Lima....338 E. High St.
Mansfield....143 E. Fifth St.
Steubenville....343 N. Seventh St.
Toledo....414 S. Erie St.
Youngstown....Jones and Brittain Sts.
Zanesville....Main and Second Sts.

OKLAHOMA
McAlester....127 East Chickasaw St.
Oklahoma....121 E. Washington St.
Tulsa....1-11 N. Boulder St.

OREGON
Portland....15th and Hoyt Sts.

PENNSYLVANIA
Allentown....311 Gordon St.
Beaver....486 Third St.
DuBois....Weber Ave. and Franklin St.
Erie....1502 Sassafras St.
Greensburg....Clark and George Sts.
Harrisburg....25 S. Tenth St.
Hazleton....223 E. Mine St.
Johnstown....Messenger St. and B. & O. R. R.
Philadelphia....Delaware Ave. and Brown St.
Philipsburg....North Front St., P. O. Box 146
Pittsburgh....1202 Chamber of Commerce Bldg.
Pottsville....Railroad and Sanderson St.
Scranton....225 Vine St.
Shamokin....Fifth and Walnut Sts.
Sharon....Budd St. and South Irvine Ave.
Spangler....Bigler Ave.
Wilkes-Barre....150-156 E. Northampton St.
Williamsport....Canal and Court Sts.

SOUTH CAROLINA
Charleston....59 Wentworth St.

SOUTH DAKOTA
Watertown....224 First Ave., N. W.

TENNESSEE
Chattanooga....600 E. Tenth St.
Knoxville....426 West Depot Ave.
Memphis....671 S. Main St.
Nashville....102-104-108 Broadway

TEXAS
Amarillo....101-105 Pierce St., P. O. Box 697
Beaumont....366 Liberty St.
Dallas....1118-28 Jackson St.
El Paso....1601 Maggoffin Ave.
Houston....812 Live Oak St.
San Antonio....Duvall and Mesquite Sts.
Waco....315 S. Thirteenth St.
Wichita Falls....1507 Lamar St., P. O. Box 1002

UTAH
Salt Lake City....108 W. Second South St.

VIRGINIA
Lynchburg....1224 Commerce St.
Norfolk....120 W. Plume St.
Richmond....1709 East Cary St.

WASHINGTON
Seattle....504 Railroad Ave., S.
Spokane....162 S. Post St.

WEST VIRGINIA
Bluefield....195 Roanoke St.
Charleston....Broad St. and K. & M. R. R.
Clarksburg....608 North Third St.
Elkins....Railroad Ave and First St.
Fairmount....Auburn St. and B. & O. R. R.
Huntington....Seventh Ave. and Elm St.
Morgantown....610 University Ave.
Mount Hope....P. O. Box 416
Mullens....P. O. Box 57
Wheeling....Forty-third and McCulloch Sts.
Williamson..Foot and W. Second St., P. O. Box 305

WISCONSIN
Appleton....909 N. Lawe St.
La Crosse....Front and King Sts.
Madison....513-19 Williamson St.
Marshfield....South Maple and Depot Sts.
Milwaukee....120 Jefferson St.

WYOMING
Casper....232 Industrial Ave., P. O. Box 971

UNION CARBIDE IS EASILY OBTAINABLE EVERYWHERE

Visit One of These Plants

Right in your neighborhood you will find one or more member plants of the Gas Products Association. Whether your oxygen requirements be large or small, your neighborhood plant is equipped to furnish you uniform quality and a high type of service.

Users of oxygen are invited to visit these conveniently located plants, learn how oxygen of 99.5%, or higher, purity is produced, why our members insist on that high standard of purity, and how their service facilities insure your continued satisfaction with gas welding and cutting.

ALABAMA

†*Birmingham—Burdett Oxygen Co.
Birmingham — Standard Gas Products Co. of Alabama.
*Mobile—Louisiana Oxygen Co.

CALIFORNIA

†*Fresno—California Compressed Gas Co.
†Los Angeles—California Compressed Gas Co.
†Oakland — California Compressed Gas Co.
†*Redding — California Compressed Gas Co.
†*Sacramento—California Compressed Gas Co.
†*San Francisco — California Compressed Gas Co.
†*San Jose — California Compressed Gas Co.
†*Stockton — California Compressed Gas Co.

COLORADO

†Denver—Colorado Compressed Gas Co.

GEORGIA

†Atlanta—Burdett Oxygen Co.

ILLINOIS

†Chicago—Acme Oxygen Co.
†Burdett Oxygen & Hydrogen Co.
†Swift and Company.
†Peoria—Electrox Co.

INDIANA

†*Evansville—Kentucky Oxygen-Hydrogen Co.
†Indianapolis—Indiana Oxygen Co.
Logansport—Logansport Oxygen Co.
†*South Bend—Burdett Oxygen-Hydrogen Co.

IOWA

†Bettendorf — Bettendorf Oxygen-Hydrogen Co.

KENTUCKY

†Louisville—Kentucky Oxygen-Hydrogen Co.

LOUISIANA

New Orleans—Louisiana Oxygen Co.
Shreveport — The Bain-Beaird Co.

MARYLAND

†*Baltimore—Southern Oxygen Co.

MASSACHUSETTS

†Everett—New England Compressed Gas Co.

MICHIGAN

†Detroit—Burdett Oxygen Co. of Detroit.
Wall Bros. Co.
*Grand Rapids—Grand Rapids Welding & Supply Co.
Muskegon — Michigan Oxy-Hydric Co.

MINNESOTA

†Minneapolis—Commercial Gas Co.

MISSOURI

†Kansas City—Kansas City Oxygen Gas Co.
†Ox-Hydrogen Mfg. Co.

MONTANA

†Butte—Mountaineers Welders' Supply Co.

NEBRASKA

Omaha—The Balbach Co.

NEVADA

*Reno—California Compressed Gas Co.

NEW JERSEY

†Newark — International Oxygen Co.
†*New Brunswick—International Oxygen Co.
†*Paterson—International Oxygen Co.
†*Plainfield—International Oxygen Co.
†*Trenton — Paschall Oxygen Company.
†*Trenton— International Oxygen Co.

NEW YORK

†*Brooklyn— International Oxygen Co.
†*Long Island — International Oxygen Co.
†*New York—International Oxygen Co.

NORTH CAROLINA

Charlotte—Carolina Standard Gas Products Co.

OHIO

†Canton—Buckeye Oxygen Co.
†Cincinnati — Ohio Electrolytic Oxygen Co.
†Cleveland — Burdett Oxygen Co. of Cleveland.
*Cleveland—Clarke Chemical Co.
Columbus—Gas Products Co.
†Dayton — Dayton Oxygen & Hydrogen Products Co.
†Niles—Ohio Oxygen Co.
†Toledo—International Oxygen Co.
Wickliffe — Clarke Chemical Co.

OKLAHOMA

†Oklahoma City—Burdett Oxygen Co. of Oklahoma City.

OREGON

†Portland—Portland Oxygen & Hydrogen Co.

PENNSYLVANIA

†*Allentown — Paschall Oxygen Company.
†*Lancaster—Paschall Oxygen Co.
*Philadelphia—Burdett Oxygen Co.
†Philadelphia—Paschall Oxygen Co.
†Pittsburgh—Burdett Oxygen & Hydrogen Co.
†Verona—International Oxygen Co.
†*York—Paschall Oxygen Company.

RHODE ISLAND

*Providence — New England Compressed Gas Co.

TENNESSEE

†Chattanooga—Burdett Oxygen Co.
†*Johnson City—Kentucky Oxygen-Hydrogen Co.
†*Knoxville — Burdett Oxygen Co.
†*Knoxville—Kentucky Oxygen-Hydrogen Co.
Memphis — Memphis Oxygen Co.
†*Nashville — Burdett Oxygen Co.

TEXAS

†*Nashville—Kentucky Oxygen-Hydrogen Co.
Beaumont—Magnolia Gas Products Co.
*Dallas—Burdett Oxygen Co. of Texas.
Ft. Worth — Burdett Oxygen Co. of Texas.
*Galveston—Gregory Auto Supply Co.
†Houston—Magnolia Gas Products Co.
*Ranger—Burdett Oxygen Co. of Texas.
*Waco—Burdett Oxygen Co. of Texas.
*Wichita Falls—Burdett Oxygen Co. of Texas.

UTAH

†Salt Lake City—Utah Compressed Gas Co.
†*Ogden—Utah Compressed Gas Co.

VIRGINIA

†*Norfolk— Portsmouth Oxygen Corporation.
†Portsmouth—Portsmouth Oxygen Corporation.
†South Washington — Southern Oxygen Co.

WASHINGTON

†*Bellingham—Washington Compressed Gas Co.
†*Everett — Washington Compressed Gas Co.
†Seattle — Washington Compressed Gas Co.
†*Tacoma — Washington Compressed Gas Co.

WISCONSIN

†*Appleton — Universal Oxygen Co.
†*Fond. du Lac—Universal Oxygen Co.
†*Green Bay—Universal Oxygen Co.
†Kenosha—Wisconsin Oxygen & Hydrogen Co.
†*Madison — Universal Oxygen Co.
†*Manitowoc — Universal Oxygen Co.
†Milwaukee—Universal Oxygen Co
†Sheboygan—Universal Oxygen Co.

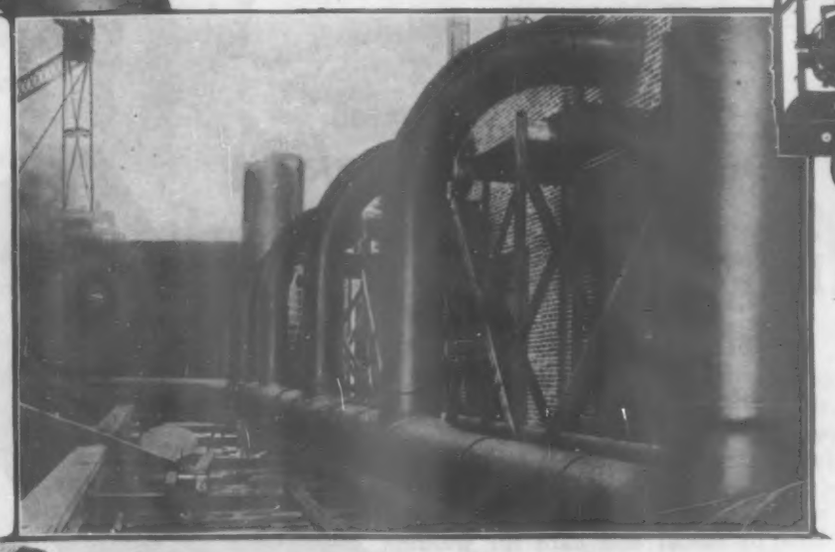
***Signifies Warehouses.**
†Plants and warehouses indicated can supply Hydrogen.

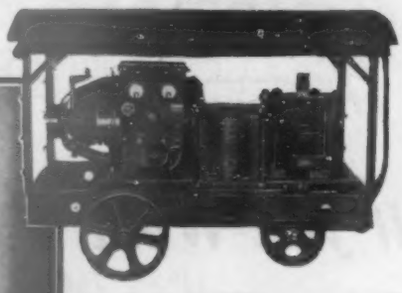
Gas Products Association

140 So. Dearborn St. Chicago, Ill.

First to Advocate High Purity Oxygen

The most complicated pipe work *is now* ARC-WELDED





Type WD Arc Welders

Reliability, heavy duty, speed, and simplicity are outstanding features of the G-E Type WD Arc Welders which are making them the most popular and widely used line in the welding field.

Arc welded offtake connections and collecting manifold for carrying hot gases from water gas machines directly to relief holder.

ANY PART of your piping system can be installed, connected, changed, or repaired to the best advantage and at the least cost by arc welding methods.

Simplify your pipe line problems! Cut out the separate fabrication of nipples, T's, L's, Y's, and manifolds. Eliminate time-taking operations such as elaborate template work, layout, punching, drilling, reaming, and riveting.

With a G-E Arc Welder in your plant, the installation and maintenance of piping systems become a minor problem of plant management. Expenses are greatly reduced, much valuable time is saved, and the welds are pressure tight with a permanent metallic seal.

The G-E Arc Welder is the outstanding choice of the foremost pipe fabricators in the country. This preference exists because the genuine value of the G-E Arc Welder, and the service that accompanies it, are unequalled anywhere.

Ask your nearest G-E sales office for advice on the welding sets best fitted for your particular needs.

In addition to a complete line of arc welders, General Electric manufactures welding electrode wire. The exceptional welds obtained from this wire are causing its general adoption wherever welding is done.

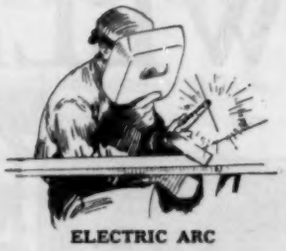
28-14

GENERAL ELECTRIC

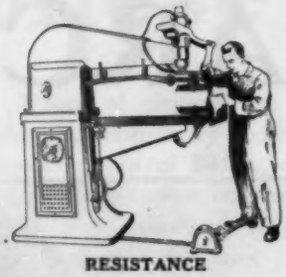
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y. :: SALES OFFICES IN ALL PRINCIPAL CITIES

No matter what kind of welding you do--

OXY-ACETYLENE



ELECTRIC ARC



RESISTANCE

THERMIT

If you Weld, you need this book

The Welding Encyclopedia

Fifth Edition

It describes in detail the theory and practice of every welding process. It tells how to weld every weldable metal by each of the welding processes. It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc. It tells how to prepare parts for welding. It tells how to install and care for welding equipment. It explains the meaning of all words and terms found in welding literature. It tells where to buy all standard makes of welding apparatus and supplies.

Price

$5.00

479 Pages, 625 Illustrations. Flexible Leather Grain Binding.

Contents

1. Illustrated encyclopedia covering all words, terms, and trade names used in welding.

2. Oxy-Acetylene Welding.—Aluminum, Steel, Cast Iron, Brass, Bronze. (Full instructions for welding each of these metals.)

3. Electric Arc Welding.—Complete instructions for welding all metals, studding, cutting, etc.

4. Electric Resistance Welding.—Includes Butt Welding, Line Welding, Percussion Welding and Spot Welding.

5. Thermit Welding.—The most complete treatise on this process ever published.

6. Cutting Metals.—Treatises on both gas and arc cutting. Includes cast iron cutting and automatic cutting.

7. Boiler Welding.—Gas and Electric Processes. Suggestions, procedure, and standards of practice.

8. Complete chapters on Pipe Welding, Rail Joint Welding and Tank Welding, explaining procedure in detail.

9. Rules and Regulations.—What can be welded and what cannot be welded. Rules also govern the installation and operation of equipment.

10. Complete instruction courses in Electric Arc Welding and Oxy-Acetylene Welding. Lessons, Exercises, Reference Readings, Examinations.

11. Charts and Tables.—A fund of welding information at a glance. Includes color chart showing colors at various temperatures, and color chart showing proper adjustment of oxy-acetylene welding flame.

12. Condensed Catalogs.—Up-to-date information about the leading makes of welding apparatus and supplies. The Buyers' Index is a convenient and reliable guide to the man who purchases or recommends welding apparatus.

The Welding Encyclopedia is Used by:

Welding Shops	Lumber Companies
Garages	Ice Plants
Boiler Shops	Power Plants
Round Houses	Auto Body Works
Car Shops	Ornamental Iron Works
Scrap Yards	Sheet Metal Shops
Refineries	Shipyards
Auto Factories	Gas Plants
Tank Builders	Foundries
Street Railways	Machine Shops
Airplane Factories	Pipe Line Companies
Steel Mills	Industrial Plants

THE WELDING ENGINEER PUBLISHING CO.,
608 S. DEARBORN ST., CHICAGO, ILL.

Please send me a copy of The Welding Encyclopedia, Fifth Edition, for which find enclosed five dollars. I understand that I may keep it for five days for examination and if it is not satisfactory I may return it and you will refund the purchase price.

Name _____

Street _____

Postoffice _____

Guaranteed Welding Steels

Success or failure in electric welding is 90% due to the welding materials.

GUARANTEED

DEPENDABLE

The best materials are the best insurance of good welds.

"Indianapolis" {Flux-coated / Heat-treated} Electrodes

Identified by the Package

Electric Railways Have Used Over 20 Million---

"Indianapolis" {Flux-coated / Heat-treated} Electrodes—

in Reclamation, Repair and Construction Welding.

"Indianapolis" stands as the PIONEER, the ORIGINATOR, the DEVELOPER of the art of applied

"METAL-ARC-WELDING" and PRODUCERS of the ORIGINAL "FLUXATED METAL ELECTRODES"

"Indianapolis" has SPECIALIZED **for 15 years** on a Special Product for a SPECIFIC PURPOSE.

"FLUXATING and HEAT-TREATING, increases the PHYSICAL 50% to 100% by test.

"THE PROVING-GROUND, the most exacting and severe,
"A Thousand and fifty Street Rys.
"This Super-Product

"Indianapolis" {Flux-coated / Heat-treated} Electrodes

is now also used extensively by Rolling Mills, Well Drillers, Dredgers, etc. demanding SUPER-SERVICE.

"THE ONLY SOURCE"

Shipped direct to USERS only, THEREBY, **guaranteed** UNIFORM, SUITABLE, DEPENDABLE insuring RESULTS.

1911—THEN AND NOW—1926

During the fifteen (15) years elapsing, since the application of Metal Electrode, welding, by The Indianapolis Switch & Frog Co., exclusively for Electric Railways (limited field) . . . . . the practice has been taken up by the Metal Industry, Universally creating a broad and diversified application of Commercial WELDING . . . . . to serve which we offer.

GENERAL WELDERS' SUPPLIES AND MATERIALS

WIRE AND RODS

Alloy Brass | Cast Iron Manganese | Iron Low Carbon Steel | Medium Carbon Steel Semi-high Carbon | High Carbon Steel Super-high Carbon Steel

ALSO

Carbons | Gloves | Helmets | Lenses | Flexible Cable

The
Indianapolis Switch & Frog Co.
SPRINGFIELD, OHIO

BOSTON ST. LOUIS LOS ANGELES SAN FRANCISCO

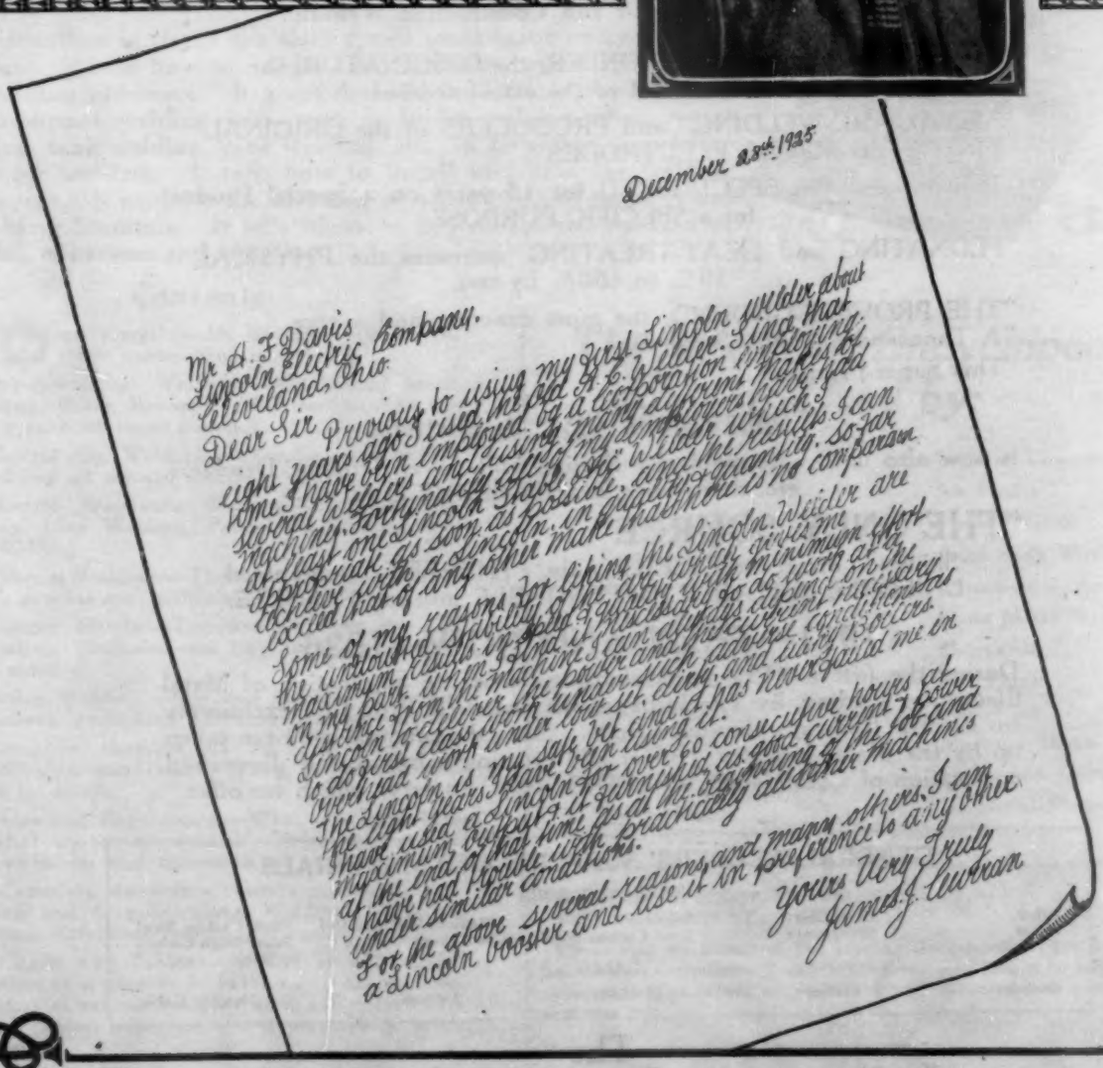
LINCOLN HONOR ROLL OPERATORS

After 8 Years

He states:

"The results I can achieve with a Lincoln in quality and quantity so far exceed that of any other make that there is no comparison."

See Letter Below



December 23rd 1925

Mr A. J. Davis
Lincoln Electric Company.
Cleveland, Ohio.

Dear Sir

Previous to using my first Lincoln welder about eight years ago I used the old A.C. Welder. Since that time I have been employed by a Corporation employing several welders and using many different makes of machines. Fortunately at least one Lincoln Welder was always in use. As soon as possible my employers made it a practice to purchase a Lincoln welder which I had learned that of any other make that there is no comparison.

Some of my reasons for liking the Lincoln Welder are the unbroken stability of the arc, which gives me maximum results with minimum effort on my part. With it I find it possible to do first class work under the most adverse conditions. The Lincoln is my safe bet and I always depend on the machine to deliver the power and quality of work as per the eight years I have been using it. I have had no trouble with it during that time as at the beginning of the job and at the end of that time it turned out as good current and I have used a Lincoln for over 60 consecutive hours at maximum output. I have also used other makes of machines under similar conditions. Practically all other machines I have had trouble with and many others. I am for the above several reasons and many others, I am a Lincoln booster and use it in preference to any other

Yours Very Truly
James J. Cullinan

The Lincoln Electric Co., Cleveland, Ohio

The Welder's Guide
In testing the strength of metal

The "pulling test" is the common method of testing steel, either Welded or not Welded.

The test piece, which may vary in size according to conditions, is placed in a machine and pulled. A beam connected with the machine registers the "pull."

The strain on the test piece is gradually increased, usually by turning finely adjusted screws, until the beam takes the "first set" which is known as *yield point.*

The maximum elastic limit, which occurs just before the test piece takes the first set, is the maximum pull which the piece will withstand and when released retain its original shape.

After the first set, more pressure is applied until the test piece breaks. The reading at this point is called *ultimate strength, breaking load,* or *tensile strength.*

Welds Made with Elecweld Have High Tensile Strength

A Practical Book on Welding
Send for Your Copy

Electric ELECWELD Arc

UNIFORM STRENGTH

In Welds Made with Elecweld

THE uniformly high tensile strength of welds produced with our ***Elecweld*** Rods was recently demonstrated by a customer who tested twelve commercial samples of 1/8" ***Elecweld*** Rods taken at random from various parts of our stock. The welding was done by an experienced welder using a standard make of motor generator electric machine. The test specimen was 2"x.187." The results were as follows:

Rod		Breaking Load, Lbs.
Bare treated, medium hard	(1)	55,000
Bare treated, medium hard	(2)	56,700
Bare treated, medium hard	(3)	58,000
Bare treated, annealed	(1)	55,200
Bare treated, annealed	(2)	57,600
Bare treated, annealed	(3)	59,500
Flux coated, medium hard	(1)	57,600
Flux coated, medium hard	(2)	59,700
Flux coated, medium hard	(3)	62,500
Flux coated, annealed	(1)	57,000
Flux coated, annealed	(2)	58,000
Flux coated, annealed	(3)	61,800

A Welding Rod for Every Job

In Acetylene and Electric Welding

Large stocks of welding rods—a rod for every job in both acetylene and electric welding—are carried in our Chicago Warehouse for immediate shipment. A few important kinds are listed below.

Norweld Special	Hicarweld	Elecweld
Norweld	High Manganese	Steelweld
Castweld	Nickelweld	Wilson Color-tipt
Bronzeweld	Elecweld Special	Vanadweld

STEEL SALES CORPORATION
129 South Jefferson Street
CHICAGO, ILL.

J. A. Roesch, Jr., *President* F. W. Walters, *Vice President*
D. R. Hoffman, *Secretary and Treasurer*

Steel, Monel Metal, Nickel, Brass, Copper, Copperweld, Nickel Silver, Phosphor Bronze, Wire Rope.

MAIL THE COUPON FOR SAMPLES

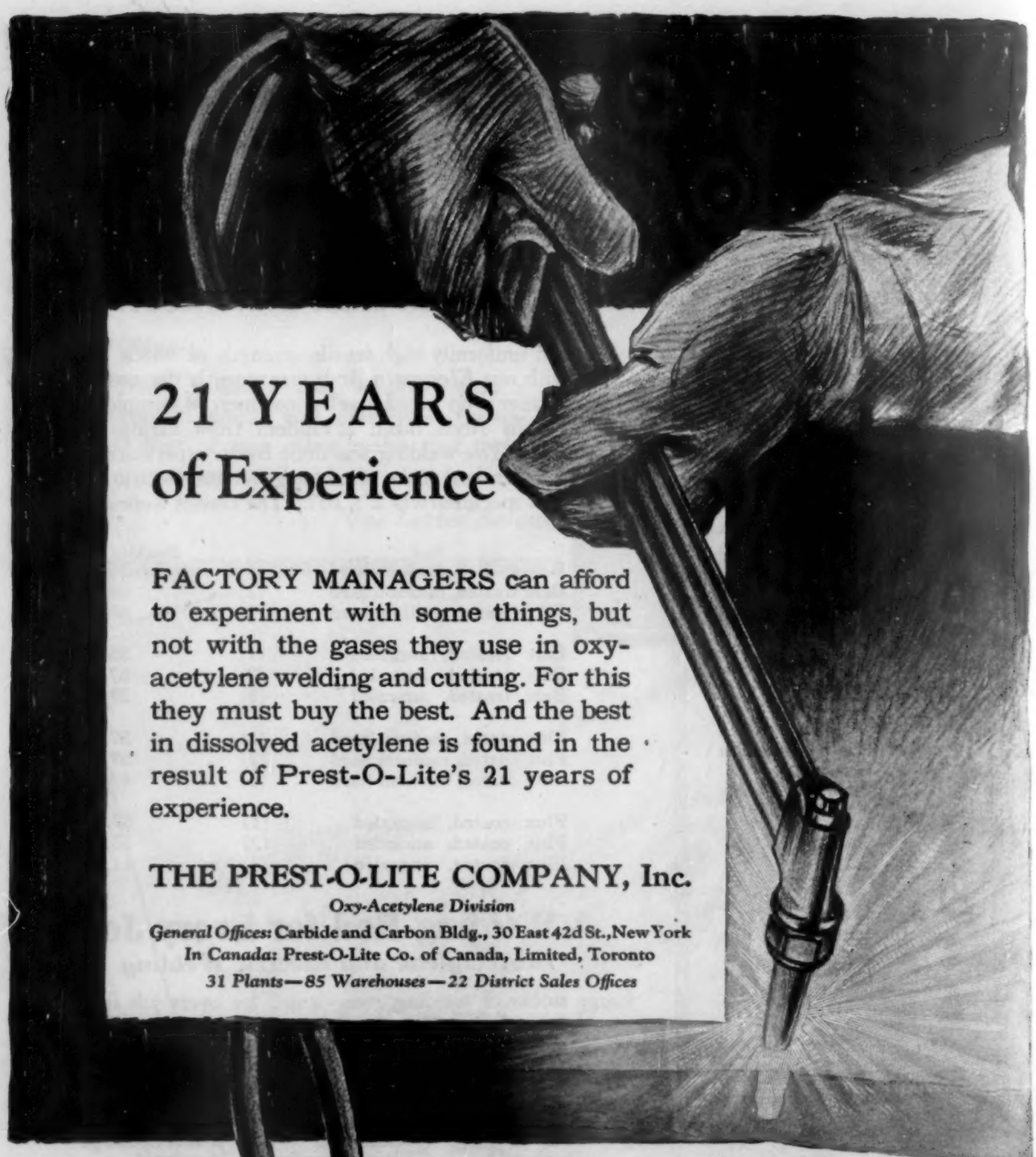
STEEL SALES CORP., 129 S. Jefferson St., Chicago WE-A
Gentlemen: Please send us samples of the following rods:—

I do— ☐ Elec. ☐ A.C. ☐ D.C. ☐ Acetylene Welding.

Firm .....

Street .....

City ..... State .....


21 YEARS
of Experience
FACTORY MANAGERS can afford to experiment with some things, but not with the gases they use in oxy-acetylene welding and cutting. For this they must buy the best. And the best in dissolved acetylene is found in the result of Prest-O-Lite's 21 years of experience.
THE PREST-O-LITE COMPANY, Inc.
Oxy-Acetylene Division
General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York
In Canada: Prest-O-Lite Co. of Canada, Limited, Toronto
31 Plants—85 Warehouses—22 District Sales Offices

Prest-O-Lite
DISSOLVED ACETYLENE

EDITORIAL

Progress Will Remove Restrictions

RESTRICTIONS placed upon the use of welding by various construction codes have undoubtedly served the useful purpose of making it necessary to use more care in the application of the welding processes. Some of these codes are a serious handicap to the progress of welding and to bring about a revision of them seems to be a somewhat complicated procedure. They really become less of a serious matter as the development of the art progresses toward the point where all operators perform their tasks under competent supervision. By competent supervision is meant supervision by someone who knows what welding is really intended to accomplish and what must be done in order to make it accomplish this end in the most efficient manner. Many examples of welded construction have already been recorded which show qualities in welded joints far superior to the qualities displayed in many pieces which have been welded for scientific tests. This is the sort of welding which is bound to play an important part in doing away with the restrictions which are now imposed on welding. Little by little our experience is growing and our volume of successful work is increasing while we are getting farther and farther away from the memory of failures which occurred in the earlier attempts to use welding. So we are getting closer and closer to the time when we will be so surrounded by examples of successful welding that an occasional failure does not occasion any comment. Failures in other types of construction are causing accidents every day. Still engineers do not condemn buildings erected by carpenters. They do not condemn reinforced concrete construction, they do not condemn railroad trains pulled by locomotives which can run off the track, in fact they do not condemn anything in quite the same way that they do welding. Given a little more time to become familiar with the fundamental principles of the process they will accept it as a matter of course. There will also be a smaller percentage of failures because none of the users of the welding process want to have failures. They know that failures are costly. They are on the watch for the causes of failures and constantly improving their operating methods so as to come as close as possible to eliminating them entirely.

Brand of Specification?

IT IS interesting to know that there is some difference of opinion on the subject of buying welding wire. Some think that the safest way to get satisfaction is to buy on specification and others take the position that the safest way is to buy a trade marked line. If the development of specifications had been carried a good deal farther than it is there might be more chance for an argument, but in the present state of affairs those who recommend buying on brand seem to have the best case. It is true that there is a tendency in different industries to develop standard specifications for the use of engineers and architects. Nevertheless, certain well known brands of materials are often specified by their trade names and manufacturers have spent millions of dollars to educate architects to specify trade marked brands of material. In this educational work they are simply calling to the attention of architects and engineers the fact that specifications cannot be made to control the quality of materials completely. This is undeniably true of the welding wire situation today. Practically the only specifications covering this material are the specifications of the American Welding Society. Practically every reputable manufacturer of welding wire advertises the fact that his wire meets the specifications. If they were complete there should be no difference in wires. It is well known, however, that many large users of welding wire can be found who will express a marked preference for one particular brand out of the many which claim to fulfil these specifications. His assurance of continued satisfaction lies, therefore, in being able to tell the purchasing agent to buy that particular brand which suits his purpose the best, and his protection against a variation in quality lies in the fact that the manufacturer has spent money in advertising to build up good will for his own brand and cannot afford to sacrifice the good will by lowering the quality of his product. Much good has been done by drawing up the present specifications that have served to increase the use of the better grades of welding wire. There is urgent need, however, for additional work in this direction. In the meanwhile the manufacturer's trade mark is a valuable asset to the welding wire user. In all probability this statement will always be true, even though the value of the specifiations themselves may increase.

Seeing the Light

INCREASED business made it necessary for one company to install two new elevators in their eleven story building. The only space available for this installation was that occupied by an old stairway. When this was removed it was necessary to put in strong cross-beams and the usual 9-inch by 3-inch by 3-inch I-beam was used. These I-beams were securely welded together in the center and at the ends and it was by no means what anyone would call a difficult welding job. However, if these beams had been riveted in this position, it would have been necessary to tear the plaster out on both sides of the original building girders and uprights, in order to drive the rivets. Welding made it possible to install these girders by simply tearing out the plaster from one side to get a butt joint onto the original girders. It is gratifying to have engineers in charge of jobs like this familiar enough with the welding process to know that this could be done. Instances like this will probably multiply because there certainly is a tendency on the part of engineers to have increasing faith and confidence in welding.

Most Accidents Can Happen Twice

A WELDER employed in one of the largest industrial plants in the central west recently lost the sight of one eye in a most unusual accident. This firm had been buying steel welding wire in coils and whenever the welders needed wire they went to the coil and cut off whatever length was required with a pair of shears. One day one of the welders was cutting a piece of wire which apparently was quite springy and the free end of the wire on the coil flew up in his face, the sharp point sticking in his left eye and destroying the sight. This story points to a hazard which is not characteristic of the welding industry and by no means limited to welders. The lesson of course is that before workmen cut coiled wire with any implement, they should take the precaution to protect their eyes by putting on a good pair of chippers goggles. It is altogether human for a workman to receive a number of minor scratches and cuts from just such a cause as this and pay no attention to the risk at all until the day comes when the accident become a real serious one such as described above.

You wouldn't buy a Podunk car!

BECAUSE, as a factory man, you know the importance of established reputation and of prompt and efficient service. That's why you buy oxygen from Linde.

Made by the largest manufacturers of compressed gases in the world, Linde oxygen has been the standard of industry since oxy-acetylene welding began.

Even more significant from the point of view of leadership is Linde service. It is gaged to meet the needs of the smallest or most inexperienced customer and at the same time it is equipped to anticipate the most exacting problems of engineering and research.

THE LINDE AIR PRODUCTS COMPANY
General Offices: Carbide and Carbon Building
30 East 42d Street, New York

37 PLANTS—105 WAREHOUSES

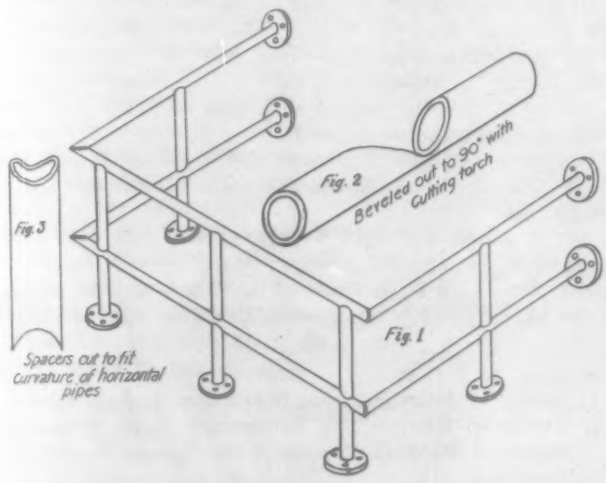
MONEL CASTINGS can be welded successfully. Even the formation of troublesome blow-holes in the face of the weld and of small cracks in the weld and the base metal can be completely eliminated by careful preheating and annealing. This subject is completely covered in a Linde Procedure Control.

LINDE OXYGEN

All Welded Pipe Railings

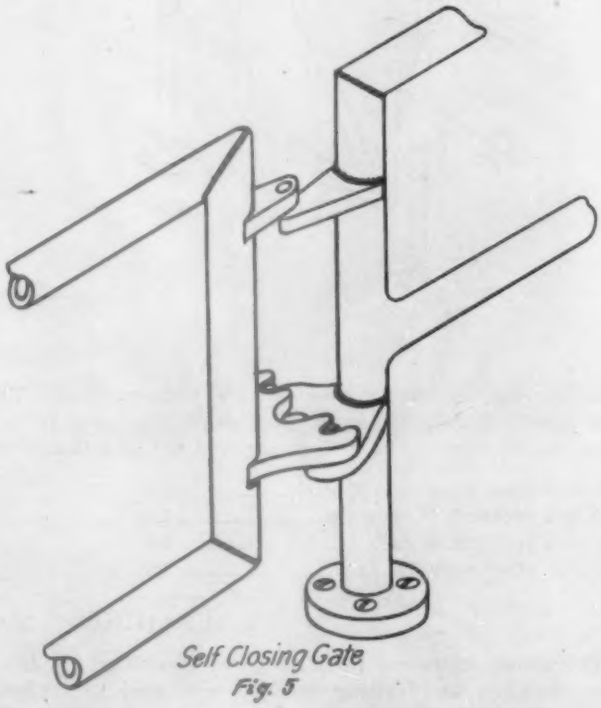
Because Fittings Were Not Available, Welding Was Tried and the Welding Department Showed How to Get a Better Railing at Lower Cost

A LARGE Eastern shop desired to have a two-inch pipe railing built on very short notice. It was found that there were no railing fittings of the desired size available, therefore the welding department was asked to do the job. The result was most pleasing to the officials of the plant, and the method of construction is one that can be used wherever welding and cutting equipment is available. By a study of Figure 1 it will be seen that all of the pipe used was of short length. No patterns of any kind are necessary, and all of the tools that were used besides the torches were a foot square, a hammer, a center punch, a pair of dividers, and a vise.



The corners of the railing are made by cutting a large vee at the desired point as shown in Figure 2, care being taken not to cut all the way through the pipe. The pipe is now bent at right angles, the joint very carefully squared and lined up, then the joint is tack welded.

The spacers, shown in Figure 3 are all cut off in the pipe cutting machine, a great deal of care being taken to see that they are all of the same length. The ends are all notched out to fit the curvature of the horizontal railings. To assemble the railing lay the top horizontal rail that has been already bent and tack welded on the floor, and space off and mark where the spacers are to go. Using the square in all directions, tack weld the spacers into a vertical position, tacking securely enough so that they will stand considerable handling. Laying the bottom horizontal railing on the floor, turn over the top one that has the spacers tack welded to it, so that the spacers point down, and place the upper railing on top of the lower one. Line up, and try the spacers with the square and tack weld. The floor flanges are made of quarter-inch boiler plate and are cut to 5 in. diameter. The bolt holes are four in number and are one-half inch in diameter. The flanges are cut with the cutting torch. The holes are drilled and the edges of the plates are cleaned before the legs of the railing are welded to the plates. The legs are made the same as the spacers, except that only one end of the legs are left square. The square end of the leg is tackwelded to the floor plate and the leg in turn is tackwelded to the railing after the railing is turned upside down. After all tacking is done the railing is turned right side up and a neat welding job is done on all joints, care being taken to see that all joints are square and in line with the other parts. The wall flanges can be welded on after all other welding is done. Two types of gates are shown here. One is a self-closing gate and swings in both directions. The other type also swings in either direction but does not return to the closed position. By an inspection of Figures 5 to 9 it will be seen that the hinges are very simple and easy to make. The lower



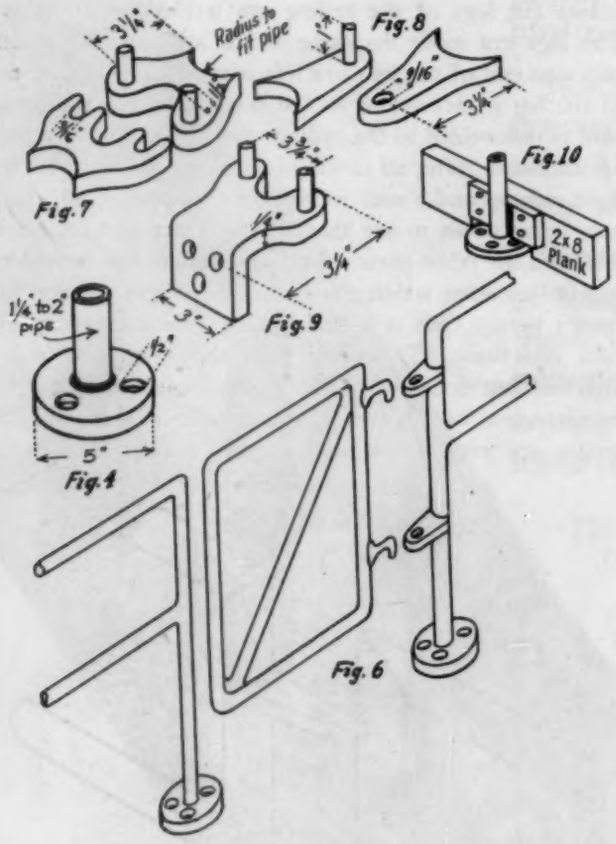
Self Closing Gate
Fig. 5

hinge, shown in Figure 7 can be altered some, for instance the distance ¾" can be more or less than shown, but if this is done the upper hinge must be altered also. Figure 9 shows a lower hinge for attaching the gate to a brick or other wall, and of course the top hinge should be designed similar to the bottom hinge.

Figure 10 shows a method of attaching a kick board to a railing. These kick boards are required by a good many safety engineers, and are used at the bottom of a railing when the railing is around an overhead platform or a pit. They prevent tools and other objects from being kicked or pushed onto workers below.

Cost Analysis

This company has built both kinds of railings, the threaded fitting railing, and the all welded railing. In both cases the men who built them were experienced men in their line. The cost analysis of the screwed fitting railing will be considered first. The railing described above will serve as the example. The pipe will not be considered, as in both cases the pipe



was old pipe and was useless for any other purpose. The railings were 15 feet long on the short sides, and 22 feet long on the front. The fittings required are as follows:

7 2-inch floor flange@$0.90 each	$6.30
3 2-inch crosses@$1.00 each	3.00
3 2-inch tees@$0.80 each	2.40
4 2-inch elbows@$0.72 each	2.88
Total $14.58 less 35@	$9.47

The above prices are listed in current catalogs. A large pipe threading and cutting machine was used to cut and thread all pipe. A fitter and a helper are necessary to construct the threaded fitting job. The railing has 32 threaded joints, and each joint takes eight minutes to cut off and thread, or a total of 4.3 hours. To assemble the fence and line it up, including the construction of the gate, consumed 5 hours. The helper and fitter get $1.15 per hour plus a 25% overhead charge. Labor cost $13.25.

$ 9.40	
13.20	
2.80	
$25.56	total cost of threaded fitting job.

To build the railing by welding, the welder worked alone, doing all cutting, grinding, drilling the floor flanges, tacking and welding, in 12.5 hours.

Welder's time is $0.70 plus 25% overhead or $1.00 per hour. $12.00

1.60 for acetylene gas

1.20 for oxygen

$14.80 is the total amount for the welded railing.

Since building the first railing there have been dozens of them built. They look good, if reasonable care is taken, during construction, they are cheap, and they are stronger than any other kind. They can be built at any angle, any height, or of any size of pipe.

SPRING MEETING OF THE AMERICAN WELDING SOCIETY

The annual meeting of the American Welding Society will be held April 21st to 23rd inclusive, in the Engineering Society's building, 33 West 39th Street, New York. Following is the official program for the meeting:

THURSDAY, APRIL 22, 1926.

Morning.

Business Session of the American Welding Society.

9:15 a. m. to 11, Room 1.

1. President's Report of Year's Activities.
2. Financial Report.
3. Membership Report.
4. Election of Officers.

Technical Session.

11 a. m. to 12:30 p. m., Room 1.

Designs of Welded Equipment for Chemical Plants. Mr. H. D. Edwards, Works Manager, Carbide and Carbon Chemical Corporation

LUNCHEON.

12:30 to 2.

Note: A luncheon for members of the Society has been arranged at the Engineers Club. Reservations should be made in advance.

Afternoon.

2:00 p. m. to 5 p. m.

1. Design of Joints in Piping Installations. L. J. Sforzini.
2. Design of Joints in Ship Construction. J. W. Owens, Director of Welding, Newport News Shipbuilding and Dry Dock Co.
3. Design of Welded Joints With Special Reference to Pressure Vessels. S. W. Miller, Consulting Engineer, Union Carbide and Carbon Research Laboratories.
4. The design of an Arc-Welded Pressure Vessel. L. H. Burkhart, Chief Engineer Struthers-Wells Co.
5. Design of Welded Joints for Tanks and Containers. A. C. Vick, Engineering Dept., Detroit Range, Boiler & Steel Barrel Co.

Note: The technical papers are planned to form a symposium on the subject of design of welded joints in several industries covering: (a) Stresses—kinds and amounts; (b) Accesibility and position; (c) Technique; (d) Type of joints; (e) Materials; (f) Thermal considerations; (g) Tighteness; (h) Tests.

FRIDAY, APRIL 23, 1926.

Board of Directors, American Welding Society.

(Including retiring and new members).

2:00 p. m. to 5, Room 1101.

(a) A review of progress during the year.
(b) Introduction of new President.
(c) Appointment of Committees.
(d) Plans for coming year.

STULZ-SICKELS CO. ANNOUNCE PACIFIC COAST APPOINTMENTS

Stulz-Sickels Co. announce that they have made the following appointment of agents: P. L. Casford, 830 Market St., San Francisco, Cal.; W. L. Colcord, 312 Commercial St., Los Angeles, Cal. They are experiencing a large increase in business, particularly on the Pacific coast.

Deposit Efficiency of Electrodes

A Study of the Factors Affecting the Percentage of the Electrode Deposited in the Weld Zone by the Metallic Arc

By J. B. Green*

WHEN an electrode is melted in metallic arc welding, part of it passes over into the weld deposit, part of it sputters away and part vaporizes. The percentage by weight which passes over into the weld might be termed the "Deposit Efficiency" of the electrode. The purpose of this study has been to determine about what efficiency might be expected from various electrodes and what factors affect this efficiency, also to gain an idea of the percentage of the electrode which sputters away and which vaporizes.

The Arcometer, a laboratory instrument developed by the Research Department of the Chicago Steel and Wire Company was used for obtaining the data. About 200 electrodes were tested covering a range of brands, compositions, sizes, surfaces, currents, etc.

The electrodes were run vertically downward against a stud 1¼" diameter. A picture of one of these studs with the deposit on it is shown in Fig. 1. This stud was placed in the center hole of a refractory hearth 6¼" diameter shown in Fig. 2. In order to standardize the tests the top surface of the stud was considered the welding zone and all metal deposited on it was considered weld metal. The hearth was assumed to receive all the sputtered metal. By careful weighing the electrode, stud and hearth before and after making a test, the amount of deposit, and sputtered metal was readily obtained and the sum of these two subtracted from the loss in weight of the electrode represents the vaporized metal.

From the data thus obtained, it seems that the following factors affect Deposit Efficiency:

1. Current, but not current density
2. Polarity
3. Thickness of Work
4. Chemical Composition of Electrode
5. Surface Materials
6. Occluded gases slag inclusions, etc.

Discussing these more or less in order, the curves in Fig. 3 indicate the effect of current and also of polarity. It will be noted that when the electrode is run negatively (regular) the deposit efficiency falls off as the current is increased, while just the reverse is true when the electrode is made positive. It should also be noted that the positive and negative lines cross. This means that at currents below the one at which the curves cross, the deposit efficiency becomes less with reversed polarity and above it, becomes greater.

These curves seem to be substantially the same for a number of different size electrodes. This indicates that the number of amperes flowing, not the amperes per square inch (current density) is the controlling factor.

As the primary change brought about in the arc by reversing polarity is one of heat distribution, it is reasonable to assume that anything which alters this distribution affects deposit efficiency. The heavier the work, the more heat is carried away from the weld; consequently, it seems logical to say that increasing the mass of the work material immediately surrounding the weld has the same tendency as reversing polarity so far as deposit efficiency is concerned.

Table I gives a good idea of the effect of Chemical Composition and also the more common surface materials used on commercial electrodes. Either the quantities of sulphur, phosphorus, silicon, etc., in the rods tested were too small for the Arcometer to detect their effect on deposit efficiency, or else they have no appreciable effect. It will be noted, however, that Carbon, Manganese, and the alloys do seem to materially affect the efficiency. No tests were made to determine the effects of these various impurities separately. Other research work, however, indicates that Carbon and Manganese affect the arc with opposing tendencies. This fact, in conjunction with the data presented here, permits formulating an hypothesis which later research will prove or disprove. The

Fig. 1. Arcometer Stud with Deposit

curves in Figs. 4 and 5 are a graphic representation of what the independent effects on efficiency might be of carbon and manganese in an electrode containing only these two impurities. The carbon graph in Fig. 4 might be said to have a negative curvature and the manganese graph in Fig. 5 a positive curvature. By means of such graphs the deposit efficiency could be determined from the chemical composition of the rod. It would be the sum of the efficiencies indicated for the carbon content from Fig. 4 and the manganese content from Fig. 5. It almost goes without saying, that such graphs would have to be drawn for specified values of all the other conditions affecting deposit efficiency. Indications are that the alloys investigated affect the arc like carbon and consequently would have a graph with a negative curvature.

Table I also indicates the marked effect of surface materials. The Natural Bare finished electrode is simply the one with which all welders are familiar. Traces of lime and other wire mill lubricants constitute the surface materials. The Black Soft Electrode is covered with a scale (iron oxide) incidental to annealing. The working qualities of this electrode are dependent on the scale not the temper of the rod as many have supposed. The Fluxed Electrodes were coated with a mixture of about equal parts of alkaline earth compounds and siliceous materials. By studying the table, several conclusions may be drawn. The Black Soft finish seems to generally

*Research Department, Chicago Steel & Wire Company.

raise the deposit efficiency, while the Flux Coating lowers it. As regards the flux coating, however, it must be remembered that the coating is weighed in with the rod and the coating probably largely vaporizes, consequently much of it is lost so far as the deposit metal weight is concerned. No reasonable hypothesis has yet been suggested explaining the effect of the surface scale on the black soft electrodes on deposit efficiency. It should be noted in the table that, in some instances, reversed polarity increases and in others decreases the efficiency. All of the tests furnishing data for Table I were run at approximately 140 amperes and with 5/32" electrodes except No. 1. Probably 140 amperes is above in some cases and below in others the crossing point of the current curves, like in Fig. 3, for the particular electrode.

In Table II, the data is presented from tests on quite a number of different coatings. These were all applied to 5/32" rods containing 16 points carbon and 42 points manganese

Fig. 2. Arcometer Hearth Showing Stud with Deposit in Position

and run at about 140 amperes. The coatings were all applied to a thickness welders are accustomed to in regular full flux coated electrodes. But few of these materials, all second class conductors, have any special interest to welding. Differences among them was one point aimed at in making the selection, and the table plainly indicates that the surface materials have a marked effect on deposit efficiency. A digression may be pardoned here which is suggested by the materials listed in Table II. Another basis for their selection was to determine, if possible whether whether there was any connection between the direction of flow of vapors or liquids in the arc and the direction of the current. Among these materials are those that gives negative ions, positive ions and others are what are called "amphoteric" meaning that they may have either polarity. The tests indicated that the direction of the current has no connection with the direction of flow of anything else concerned wih the arc.

The tests furnishing the data for Table III were calculated to permit studying several aspects of this subject of deposit efficiency. Two wild flowing rods are included and one very smooth flowing, the surface of which was treated in two ways, differing very slightly. The rods must be described before the data in the table can be interpreted. The No. 30 rod contained approximately 30 points carbon, and 53 points manganese intermediate between the high and low carbon series. It was subject to acid corrosion in the wire mill pickle and it contained a substantial quantity of occluded hydrogen. The surface was the natural bare wire mill finish. It was a fairly wild flowing rod.

The 3½% Nickel was selected because it is generally considered to be so wild flowing that it is entirely unsuited to metallic arc welding. It was decided to flux coat this with a special flux developed by the Research Department for laboratory use. It is often desirable in research work to be able to produce a far steadier arc than is possible with any of the commercial coatings and that is the characteristic of the special coating. 3½% Nickel does not seem subject to corrosion by the wire mill pickle and consequently should be free from occluded hydrogen. The other rod was a No. 10 containing slightly less than 10 points carbon and about 35 points manganese. Surfaces were applied to this rod similar in their working properties, but not identical with our Weldite Green Surface. This surface is composed of second class conductors and the materials are applied a little heavier than those represented by the residual lime on bare rods but not as heavy as a flux coating. One of such surfaces was applied to the No. 10 Rod composed of lime and wire drawing grease and the other composed of lime and wire drawing soap, all these materials being lubricants commonly used in drawing welding wire. As the grease and the soap are chemically quite similar, there was very little difference in the two No. 10 electrodes.

Table III is largely check runs and an object in compiling this data was to get an idea of the probable error in all these

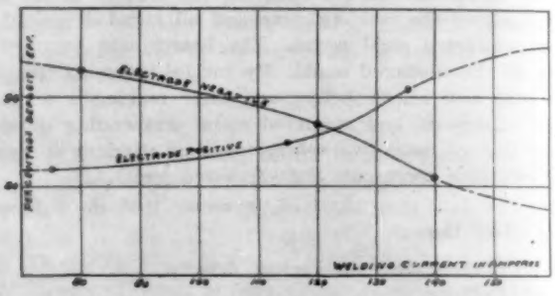


Fig. 3. Curves Indicating Relation Between Current and Deposit Efficiency

tests. It will be noted that one negative and one positive run in the series on No. 30 rod have been thrown out as deviating from the other runs so far as to indicate some variable, which should have been held constant, was not. The remaining runs are averaged and the maximum deviation from any one run noted. This deviation runs from 3 to 7 per cent. The data for the 3½% Nickel Steel was similarly handled and the deviation is shown to be from 2 to 7 per cent. In the case of the runs on No. 10, this deviation is only 1% or 2% except on the positive Grease Drawn runs. This indicates that the probable error in determining deposit efficiency by means of the Arcometer is very small being 7% maximum in the case of rods flowing so wild as to be readily distinguished as having no commercial value without any special testing. On rods of apparent commercial value, the probable error seems to be only 1 or 2 per cent.

There is a greater probability of error in the arithmetic involved in compiling this data. Most of it has been checked but there are admittedly some inconsistencies and these might, with additional checking, be traced to errors in computation.

Consider another point this table brings out. The efficiency of the No. 30 rod should fall between those of the low and high carbon groups as recorded in Table I. It does not, but instead falls several per cent below the high carbon group. Apparently this can only be accounted for by the presence of a large quantity of occluded hydrogen in the rod. The 3½% Nickel Rod also falls below the efficiency reported for

this same grade rod in Table I and yet it is presumably gas free. It must be remembered, however, that this was a flux coated rod, so in view of the explanation already given reference efficiencies from fluxed rods, the deposit efficiency is surprisingly high in this case.

The data derived from tests on No. 10 rod with the two slightly different surfaces indicates what very small differences in deposit efficiency the Arcometer can show. The grease drawn rod shows just a little higher than the soap drawn. The fact of the matter is, the soap drawn rod is just a little better for welding because, from data not included in the table, it is evident the difference in efficiency is apparently due to difference in arc length. In all these tests, the arcometer was run at optimum, or easiest held arc length, which happens to be one-half maximum arc length. The greater the maximum arc length the more stable the arc. The grease drawn wire had the shorter optimum arc length therefore the arc was less stable but the shorter arc length allowed less metal to sputter and vaporize away thus showing the higher efficiency.

There seems to be no doubt that arc length is a factor affecting Deposit Efficiency and, as such, should be included in the list of such factors given near the beginning of this article. At the time the tests were made, the Arcometer was not equipped to operate except at optimum arc lengh. As this is the length probably most often held by the welder, the tests more nearly reflect actual conditions than if the arc length had been under artificial control and held constant. If the arc had been held at constant length instead of constant optimum, the curves in Fig. 3 and, in fact, all the data would probably be different. It is easy to imagine, at least in a general way how the data would be affected by remembering that the longer the arc, the greater the air contact of the arc passed metal, vaporization and, in some cases, sputtering, being thus increased.

In Table III not only the deposit efficiency is given but also the percentage of the electrode sputtered and vaporized.

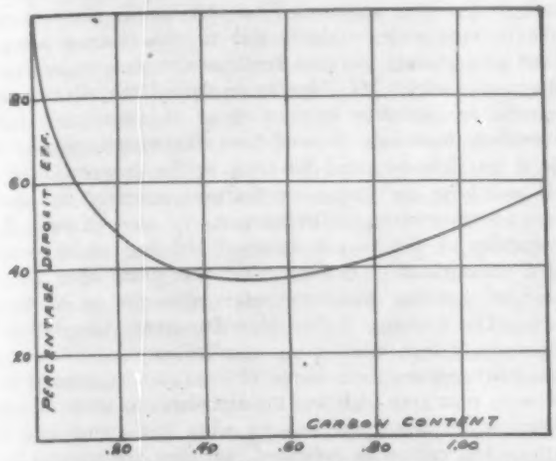


Fig. 4. Hypothetical Curve Indicating Probable Independent Effect of Carbon Content on Deposit Efficiency

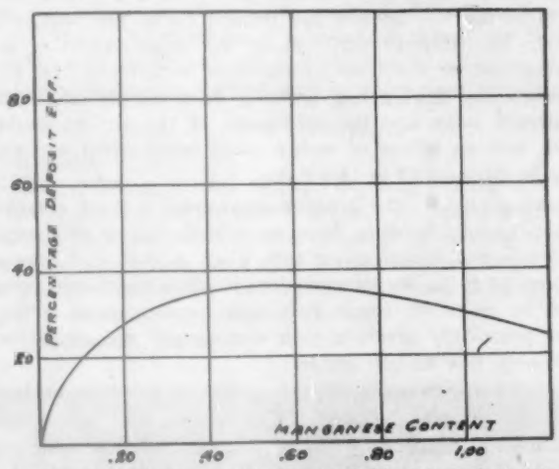


Fig. 5. Hypothetical Curve Indicating Probable Independent Effect of Manganese Content on Deposit Efficiency

TABLE I

Effect of Chemical Composition, Surface Materials and Polarity on Deposit Efficiency

CHEMICAL COMPOSITION OF ELECTRODE						PERCENTAGE DEPOSIT EFFICIENCY							
						Natural Bare Finish		Black Soft Finish		Bare Electrode Fluxed		Black Electrode Fluxed	
Carbon	Manganese	Chromium	Vanadium	Molybdenum	Nickel	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
.03	Trace	....	....	....	....	....	....	72	81	....	....	....	....
.04	.04	....	....	....	....	88	84	....	....	....	....	....	....
.06	.08	....	....	....	....	89	87	93	88	56	74	70	72
.08	.32	....	....	....	....	74	81	89	70	62	73	73	82
.16	.42	....	....	....	....	77	79	81	81	62	63	....	....
.60	.36	....	....	....	....	62	66	68	78	75	68	....	....
1.08	.63	....	....	....	....	63	79	74	81	72	72	79	85
.18	.43	....	....	....	3.54	69	65	....	....	....	....	....	....
.49	.70	.99	.16	....	....	60	53	....	....	....	....	....	....
.47	.59	.69	....	.37	....	64	59	....	....	....	....	....	....

TABLE II

Effect on Deposit Efficiency of Various Chemicals used as Flux Coatings

BASE METAL	PERCENTAGE DEPOSIT EFFICIENCY											
	Oxide		Di-oxide		Tri-oxide		Sulphide		Sulphate		Carbonate		Acid	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
Copper	75	85	....	....	....	....	72	81	....	....	76	74	....	....
Lead	72	80	....	....	....	....	76	78	72	80	73	76	....	....
Antimony	....	....	....	....	61	73	....	....	....	....	....	....	....	....
Zinc	70	74	....	....	....	....	78	76	....	....	....	....	....	....
Aluminum	67	67	....	....	....	....	....	....	....	....	....	....	....	....
Manganese	72	75	72	74	....	....	....	....	73	73	67	74	....	....
Calcium	....	....	....	....	....	....	83	85	....	....	70	70	....	....
Silicon	....	....	65	56	....	....	....	....	....	....	....	....	....	....
Boric	....	....	....	....	....	....	....	....	....	....	....	....	64	59

Note: The Deposit Efficiency of a rod, cut from the same bundle as was used in obtaining all the data for this table, is Negative 77% and Positive 79% in the Natural Bare Fnish.

TABLE III

Data on Percentages of Electrode Deposited, Sputtered and Vaporized

NUMBER OF CHECK RUN	No. 30 ELECTRODE						3½% NICKEL						No. 10 GREASE DRAWN						No. 10 SOAP DRAWN					
	Negative			Positive			Negative			Positive			Negative			Positive			Negative			Positive		
	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized	Deposited	Sputtered	Vaporized
1	59	25	16	62	24	14	56	24	20	64	13	23	86	7	7	85	4	11	83	8	9	83	9	8
2	58	30	12	64	21	15	59	21	20	61	16	23	88	7	5	90	4	6	85	9	6	83	9	8
3	55	30	15	56	25	19	55	26	19	56	21	23	88	6	6	81	10	9	83	10	7	83	9	8
4	54	26	20	*29	*27	*44	*47	*40	*12	55	26	19	...	...	...	...	...	...	...	...	...	...	...	...
5	65	23	13	56	25	19	50	25	16	54	24	22	...	...	...	...	...	...	...	...	...	...	...	...
6	*59	*15	*26	54	30	16	*46	*32	*22	60	21	19	...	...	...	...	...	...	...	...	...	...	...	...
Average	58	27	15	58	25	17	57	24	19	58	20	22	87	7	6	85	6	9	84	9	7	83	9	8
Deviation	7	5	5	5	5	3	2	3	3	6	7	3	2	1	1	5	4	3	1	1	2	0	0	0

*Eliminated from averages.

As this table includes rods giving extreme values of efficiency, it should permit studying the whole range. It will be *noted* that the No. 30 rod sputtered not quite but nearly twice as much as it vaporized. These figures further indicate the presence of gas as the cause.

In the case of the 3½% Nickel Rod, substantially the same percentage was sputtered as vaporized. The vaporization of the flux coating accounts for this. There was probably not much more of the metal vaporized than in the case of the No. 10 Rod, the rest being coating. From all these figures it might be safe to draw a generalization. Apparently, in a commercially good flowing rod, from five to ten per cent is vaporized by the arc and from 5 to 10 per cent is sputtered. Probably 10 per cent of the total weight of a flux coated rod is lost due to the flux vaporizing. In a non-commercially flowing rod, probably 20 to 25 per cent could be sputtered away and the wilderness of the arc no doubt exposes such an excess of molten metal surface that vaporization may be increased 10 to 15 per cent.

Saying all this the other way around, a good commercial rod will probably show from 80 to 90% deposit efficiency and the same rod fluxed about 10% less. A poor rod may show as low as 50 to 60 per cent deposit efficiency. Little comment need be made on Black Soft rods because other considerations practically preclude their commercial use except in the extremely low carbon grade.

If an editorial conclusion is pardonable, it might be said that this study of deposit efficiency is only one phase of welding rod phenomena out of a great many on which work has been done by the Research Department. The reader probably never realized until now how many angles there are to this one subject, deposit efficiency. Still, there are many welding subjects far more complex. Welding phenomena are not simple. They are highly complex, highly technical. Too many are prone to say "Hush!" when an attempt is made to involve science with welding, usually on the excuse that it might be over the head of the welder or somebody. Every such "hush" holds back the development of welding. Probably no art needs more the work of the scientist than welding does today. The welder is an intelligent man. He can and wants to learn, in fact his desire and ability to learn seems to far outstrip the desire to teach him on the part of most of those who should be interested and capable. Space limits mention of all deductions which might be made from the data published with this article. Study the data and see how many more deductions can be added. Get the research habit. Because a matter is scientific is no reason to assume it will bite.

(NOTE—This is one of a series of articles by Mr. Green in which the welding qualities of electric and gas welding rods will be discussed. The observations made and conclusions drawn are the result of a long series of experiments but it is recognized that other investigators may have formed different conclusions as a result of experiments made in other ways. Correspondence is therefore invited on the subjects covered, in order that any errors made in conclusions may be corrected and any data which serves to confirm the conclusions given will also be welcomed. It is felt that much good will result from a thorough discussion of the different characteristics of welding rods and wire-Editor.)

J. C. LINCOLN TALKS TO CHICAGO BOILERMAKERS

On Monday, April 5th, Mr. J. C. Lincoln of the Lincoln Electric Company, Cleveland, Ohio, gave a talk on welding, at the monthly meeting of the Chicago Boiler Manufacturers' Association which was held in the new Palmer House, Chicago. After treating briefly of the history of the electric welding process Mr. Lincoln showed, by means of diagrams, why the welded joint is superior in strength to the ordinary riveted joint, provided the welded joint is properly made. Wherever failures have occurred it has not usually been because the fault lies with the welding process but because the process has not been properly used. A careful distinction was made between the carbon arc process and the metallic arc process, with particular reference to the differences in the method of distribution of heat, returning then to the subject of the efficiency of the process. Mr. Lincoln pointed out that some very searching tests which have been made on the welded structures show that with careful workmanship the welded joint can be expected to have a minimum efficiency of ninety per cent. That this fact is not recognized in the present boiler code is due to the process being restricted as a process and as a result of complete understanding of its possibilities. Mr. Lincoln explained the advantages of automatic arc welding in treating of the automatic carbon arc welding machines showed how the distribution of heat made it possible to avoid beveling in the preparation of the work and how the automatic features operated to produce more uniform results. Moving pictures were shown of the construction of the two story steel building which was arc welded throughout. The meeting was then open for discussion of welding with particular reference to its use on boilers. The Chicago Boiler Manufacturers' Association has an exceedingly high membership, considering the limited number of possible members there in the Chicago district, interest in the association runs very high and the attendance is uniformly large. Welding is an important subject with this group and their questions and criticisms indicated that they are anxious to get fully posted on the possibilities of the process and also to get at the reasons for difficulties which they have encountered in the past.

CARBON BLOCKS MAKE FORM WELDING EASY

In a recent issue of "Power" is a short description of the repairing of water wheels in the power mine, at Shawinigan Falls, by electric welding. The runner buckets on these water wheels had become badly eroded. These runners were made of cast steel and it was decided that they could be put back into condition by electric welding. The cost of restoring the buckets to service was about $6.55 each. The welding on forty-two of them was done by one man, using a current of 175 amperes and a 5/32 inch welding rod. The job was greatly facilitated by the use of carbon blocks which were ground to the shape of the inside of the bucket, using these as a form against which to work, made progress in building up the runners easier. Each course was hammered as soon as it was put on. A great many welders, when starting a job of this kind, forget all about the usefulness of carbon blocks and are put to a great deal of extra trouble and labor to procure the desired shapes.

NEW OFFICERS FOR DETROIT SECTION A.W.S.

At a meeting of the Detroit Section of the American Welding Society held March 3rd, the following officers and directors were elected: Chairman, W. C. Sprau, Barnes Wire Fence Company, 10371 Northlawn Avenue, Vice Chairman, R. K. Slaymaker, Slaymaker Welding Company, Secretary and Treasurer A. W. Fry, C. A. Strelinger Company. Executive Committee—W. C. Sprau, R. K. Slaymaker, A. W. Fry, J. G. Lincoln, H. M. Gould, V. E. Cornell, F. X. Wells, C. E. Phillips. Committees—Meetings and Papers Committee, Chairman Cornell, Heckman Lincoln. Membership Committee, Chairman Lincoln, Wells, Doud, Manor. Representative on Nat. Bd. of Directors, H. P. Loud. Two representatives on Amer. Bureau of Welding C. A. Moore and F. W. Steere. Member of National Membership Committee, J. G. Lincoln. Representative on National By Laws Committee, C. Centers. Councilors (2) with Associated Technical Societies of Detroit, W. C. Sprau, H. M. Gould.

"Stelliting," a Special Process

How the Application of Stellite to Metal Surfaces Differs from Ordinary Gas Welding Practice

STELLITING is the term which has been applied to the process of flowing Stellite onto a metal surface so as to unite with it and form a permanent coating. Stellite, the product of the Haynes Stellite Company, of Kokomo, Indiana, is an alloy consisting essentially of chromium, cobalt and tungsten. It is more expensive than steel to produce, consequently bulky tools or parts made of Stellite are high in cost. Consequently the possibility of using a less expensive metal for the base and applying just enough Stellite to obtain the full advantage of its peculiar and valuable properties, is an attractive economical alternative.

In the course of a dozen or so years of usefulness this alloy has become widely known in metal working plants, where it has formed cutting tools of all kinds. Here use is made of the outstanding property of Stellite, that of retaining a high degree of hardness up to a bright red heat, only a very slight drop in hardness being noted in a range of temperatures which quickly softens the high speed steels. The original hardness is resumed when Stellite is cooled. But in addition to these properties, it has been found to be highly resistant to abrasive wear and to the corrosive action of acids and chemicals.

It follows that the development of a practical and economical method of applying Stellite makes it possible to effect manufacturing economies through the surfacing of heavy machinery parts and through other applications where high mechanical strength and great resistance to heat, abrasion and corrosion are necessary. Worn out parts may be salvaged instead of discarded and the life of steel parts may be increased.

There was recently published by the Haynes Stellite Company a book entitled, "Stelliting of Metal Parts," which contains a "Procedure Control" for the application of Stellite to the ferrous metals. Through the courtesy of the publishers several of the illustrations and the major portion of this procedure control are reproduced here.

Stellite can be applied by the oxy-acetylene blowpipe to almost every metal in common use. Any grade of steel, no matter what the carbon content, can be Stellited. Alloy steels of all compositions are readily surfaced. Cast iron, semi-steel and malleable iron can be Stellited successfully. The following discussion gives detailed instructions on the process of Stelliting these metals. Haynes Stellite can also be applied to copper by a process which differs in some respects from the one described here.

To "Stellite" a surface successfully, two things must be avoided:

1. Blowholes on or beneath the Stellite coating.
2. Checks or surface cracks caused by uneven cooling.

Thorough preheating and annealing of the base metal is most essential. Although the melting points of steel and Stellite do not differ greatly and the coefficients of linear expansion are approximately the same, Stellite goes from the liquid to the solid state at a lower temperature than steel. Therefore, unless the steel is preheated evenly, kept up to heat, and cooled slowly, internal strains will be set up which are great enough to check the Stellited surface. Proper preheating also facilitates the Stelliting operation and the quick removal of scale.

Stelliting is not welding. In actually performing the operation a technique is developed which differs from any other operation with the blowpipe. First, the flame should be almost parallel to the surface being Stellited and two or three inches of the rod should be enveloped by the flame. This keeps the rod hot so that when the base metal just begins to "sweat" the Stellite can be flowed on quickly. Speed is essential in order to get a very thin first coating, upon which later to build. Furthermore, the horizontal flame lessens the possibility of heating too deeply into the base metal and forming a "crater," which causes trouble in obtaining a clean surface of pure Stellite. A clean Stellite surface, free from blowholes or iron alloy, is the effect that must be obtained.

The only other precaution to be emphasized is that all scale, dirt and foreign material must be removed before the Stellite surface is applied. If such material remains, it will cause blowholes which render the Stellited part unfit for most purposes.

A. Check of the Welders

1. Experience.

Welders should preferably be experienced in welding cast iron and bronze-welding cast or malleable iron. A general knowledge of welding, however, is acceptable, provided the operator is careful and conscientious in his work. It must be remembered, however, that Stelliting is not welding and requires a different handling as described in the following sections.

2. Qualification Tests.

Correct Position for Stelliting Flat Surfaces

Before being allowed to perform any regular production work each welder should be given sections of scrap steel or cast iron plate, or both, if the requirements of the work include both metals. The plate dimensions where practical should conform to the average type of work to be done.

The plates should be properly prepared and the test specimens made, following the instructions as given below.

The test should consist of grinding off the surface and examining the ground off surface for blowholes or checks. The specimen should then be cut with a rubber wheel and the fusion of the Stellite to the parent metal noted.

B. Selection and Inspection of Material

1. Rods.

A standard Stellite welding rod is the essential requirement and should be used for all types of Stelliting.

Rods of ¼ in. diameter should be used when the surface to be Stellited is of small area or the parent metal is of thin section. On heavier material or large surfaces ⅜ in. rod may be used.

2. Apparatus.

The size of the blowpipe to be used is dependent upon the dimensions of the piece to be Stellited. A tip one size larger than is recommended for welding steel should be used, as the reducing flame employed (see section "E") lessens the effective blowpipe temperature.

3. Preheating Facilities.

Charcoal, charcoal and gas, oil or gas furnaces may be employed.

On small steel pieces the blowpipe may be used for preheating purposes—a quick surface heat only is required. For the occa-

sional bulky casting a temporary charcoal and fire brick furnace will prove satisfactory. Where the work is of a repetitive nature, however, a permanent gas or oil furnace may be more economically employed. Because of its highly localized heating effect coke should not be used.

4. Annealing Facilities.

Where a temporary firebrick furnace is used the annealing of the piece may be accomplished in it. Otherwise, a box or bin filled with some heat-resisting material should be provided. The bin should be constructed so as to enable the piece to be placed within it and completely submerged.

5. Flux.

For ordinary work the use of flux is unnecessary and not recommended. When employed in special cases, however (see section "E") it should be used sparingly.

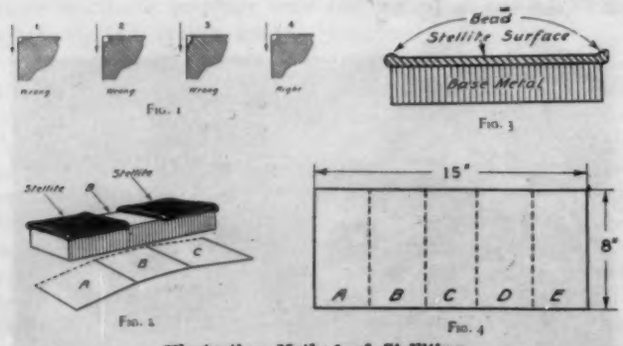
C. Design and Layout of Stellited Surface

1. Flat Surfaces.

The parent metal should be ground so that the portion to be Stellited is free from all oxide and scale.

2. Corners.

Where the Stelliting operation consists of building up a die corner, etc., the piece should be beveled in a cup shape, as shown in Figure 1.



Illustrating Method of Stelliting

The Stellite should be thoroughly fused with the parent metal and be free from blowholes, air pockets, oxide inclusions or other defects. A reinforcement of $\frac{1}{16}$ in. should be allowed for grinding.

D. Preparation of the Piece for Stelliting

1. Cleaning.

All oxide, scale or other foreign substances should be removed by grinding from the area to be Stellited. Where the piece is of such design that the area to be cleaned is inaccessible for grinding, flux may be used just preparatory to Stelliting (see section "E").

2. Alignment.

The piece should be lined up in much the same manner as in cast iron welding, the area to be Stellited being aligned in an approximately horizontal plane and supported in such a way as to prevent warpage.

3. Preheating.

The piece should be slowly and evenly brought up to a dull red heat or a temperature of about 1,200 degrees F. It is essential that this temperature be obtained before the Stelliting of the surface is started.

E. Technique of Stelliting

1. Temperature.

The piece should be maintained at an even heat throughout the Stelliting operation and at the approximate temperature arrived at in preheating.

Where a permanent preheating furnace is used and the piece is removed from the furnace during the Stelliting operation, it should be covered with asbestos paper to protect it from drafts and uneven cooling.

2. Flame.

A reducing flame (excess of acetylene) should be used in Stelliting. The flare or outer cone denoting an excess of acetyl should extend double the length of the inner cone. It will found that the inner cone lengthens out slightly and becomes perceptible as the acetylene in the flame is increased, but the pro proportions of the inner to the outer cone may be determined w a little practice.

Where too little acetylene is used, the puddle will foam bubble, forming blowholes, caused by the oxidation or burni of some of the constituents of the Stellite. If too much acetyle is used on the other hand, it will be evidenced by an excess coating of carbon surrounding the Stellite puddle. This fla furthermore, will reduce the speed of welding, but is prefera to the flame containing insufficient acetylene.

3. Tinning.

Where the surface to be built up is of small area it may entirely tinned at one time. The flame should be played on small area in one corner of the piece until its temperature elevated to a point where the carbon coating deposited by th reducing flame disappears and the base metal begins to sweat The rod should be brought to its fusion point at the same time by immersion in the blowpipe flame; a drop of the Stellite should be allowed to drop on and fuse with the sweating base metal. If the Stellite gathers in a ball, as happens when a drop of water is placed on an oily surface, it indicates that the parent metal has not been brought up to the proper Stelliting temperature and this condition must be remedied before adding further rod.

If properly applied the Stellite should then flow in and fuse readily with the parent metal. In tinning the remaining surface the blowpipe flame should be kept ahead of the melted pool of Stellite in order to bring the parent metal up to the proper fusion temperature as the work progresses. The rod should be kept in the molten puddle, but should be agitated as little as possible and prevented from digging into the parent metal.

If any scale or dirt adhere to surface of the parent metal it is important that the parent metal be brought to the fusion point before the Stellite is run onto it. The Stellite will run under the scale or other impurities and float them to the surface. If the metal surrounding the impurities has not been brought to the molten state, however, the Stellite will not float the scale and in covering it will form a blowhole at this point.

The removal of the scale is quite similar to the removal of sand in cast iron welding, the flame being played on the surrounding metal until the impurity is floated in it. An effort should be made in this operation, however, to melt as thinly into the parent metal as possible in order to minimize the thickness of the layer in which some of the parent metal has been alloyed with Stellite.

Where the section to be Stellited is of such an area that the operations of tinning and building up cannot be accomplished without a rest interval being taken by the operator, only that portion should be tinned which can be built up to the required height before a rest period is taken.

If the design of the piece is of such a nature that it is inacessible for grinding, a good grade of brazing flux may be used to help float the scale before tinning the surface with Stellite. Flux should be used sparingly and only where necessary.

In tinning cast iron more of the parent metal will have to be fused, because of its more porous structure and characteristic action when subjected to the blowpipe flame. Tinning cast iron differs from tinning steel, therefore, in somewhat the same manner that welding differs from brazing.

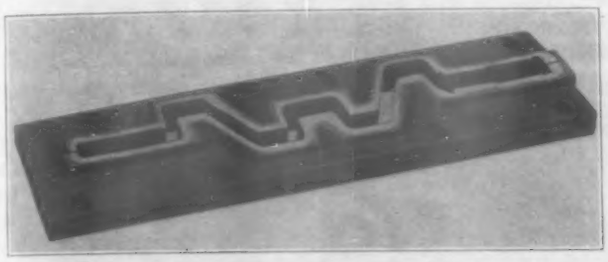
4. Building Up.

After the surface has been tinned and thorough fusion and elimination of blowholes accomplished, it may be built up to the required dimensions. The building-up operation from this point consists of adding Stellite to Stellite and is therefore comparatively simple, provided the proper procedure has been followed in tinning.

One corner of the tinned surface should be brought up to its fusion point, which will be noted by its oily appearance, and the filler rod added as in the thinning operation. Care should be exercised to confine the limits of the Stellite puddle to the envelop-

ing blowpipe cone in order to prevent oxidation. In Stelliting cast iron, on account of the intermingling of the two metals during the tinning operation, it is necessary to add a heavy top layer of Stellite in order to insure that the surface be pure metal. Stellited surfaces cannot be bent or hammered back into shape when warpage of the piece occurs. For this reason when the piece to be Stellited would have a tendency to warp should it be built up in one operation, the tinning and building up should be done in sections in such a manner as to compensate for this effect. The sketch in Figure 2 illustrates the point in question. If the bar were built up in one operation the piece would have the tendency to warp, as shown in sections A, B, C.

By Stelliting sections A and C the piece may be straightened before section B is built up. The necessary bending will take place in section B where the strains set up will not be detrimental. After straightening, section B may be Stellited.



Crankshaft Trimming Die—Stellited and Finish Ground.

It should be remembered in this connection that wherever Stelliting is done in section blocks, the sides to which another block is to be fused should be left with a rounded edge, as indicated in Figure 3, so that proper fusion with the parent metal and Stellited block may be made at this point.

Stellite is very nearly as fluid as cast iron and where it is necessary to build up a square corner the same general practice should be followed as in cast iron welding. This may be done by reducing the size of the blowpipe head or flame and building up a head of Stellite over the rounded corner, as shown in Figure 3 above. By grinding down this surface a square corner may be obtained.

In Stelliting a large area of about the dimensions as given in Figure 4, it is advisable to build it up in sectional blocks rather than attempt the entire area in one operation. As previously mentioned each section should be tapered along the line of junction with another section so that the proper fusion may be obtained. It is advisable, furthermore, to follow the procedure above outlined to eliminate warpage, namely, of Stelliting sections A and B, and D and E, and then straightening the piece before section C is built up.

5. Annealing.

Following the completion of the Stelliting operation, the piece should be reheated until an even temperature is secured throughout. It should then be cooled slowly and evenly in some form of an annealing bin or furnace.

It is essential that a slow and even cooling be obtained, for although the coefficients of linear expansion of steel and Stellite are about the same, the specific heat of Stellite is considerably lower than that of steel.

F. Inspection

The person in charge of inspection should be responsible for the quality of the work.

He should see that the pieces are properly prepared for Stelliting, properly preheated and that the recommended technique for Stelliting is carried out.

Where inspection after grinding reveals blowholes or cracks in the finished piece they should be eliminated in the following manner:

The piece should first be brought to the proper preheating temperature. Where blowholes exist, the Stellite should be melted around the blowhole until the scale or other impurity causing it has been floated to the surface. Where checks are evidenced, the Stellite should be melted down until the fine white line which shows up under the heat from the blowpipe has been eliminated. The metal may then be allowed to run together and any necessary Stellite added to bring the surface up to its required height.

While these instructions are not intended to enable a man to do a first class job on his first trial, they are sufficiently clear in detail to make it possible to develop the necessary skill in a reasonable time, with the knowledge that the process itself is entirely practicable. A great many uses for it naturally suggest themselves. This is a subject which was covered by Mr. A. V. Harris, of the Haynes Stellite Company, in a paper which he recently read before a meeting of the American Welding Society, in Boston. One case mentioned was a forming die worth $50.00, which produced a maximum of 10,000 articles before it was discarded and when reclaimed by the above process at the cost of $10.00 it produced 100,000 pieces. In the same shop the production capacity of another die was raised from 2,000 pieces to 7,000 pieces. Parts treated in this manner, it was pointed out, can always be restored to their original long period of usefulness by another application of the process.

In industries where crushing and pulverizing equipment is used the life of screw conveyors to transport ground material has been increased by Stelliting the first few flights where the great wear occurs. The ability of the alloy to retain its hardness at high

Punch and Die Operation **Hot Trimming Die**

temperature accounts for its usefulness in the metal cutting field. This is important because in many die operations, especially where forgings are trimmed, the work must be kept red hot during the operation.

An interesting application was found in the cement industry, where white hot clinkers are taken away from the kiln by a drag chain. The supporting bar and plate on which the chain travels is subjected to the intense heat of the white hot clinker and the abrasion of the claim at the same time. The riding bars surfaced with Stellite, have shown remarkable durability in this service.

An instance of the importance of resistance to chemical corrosion is found in the manufacture of dry batteries, where a number of dies and machine parts come into contact with active chemicals which tend to corrode and destory the texture of the metal. Stelliting has greatly increased the life of dies and machine parts in cases of this sort.

The term Stelliting then, will stand as a brief title for the solution of a great variety of production problems. The experimental work which has led up to the development of this process makes it possible for the owner of oxy-acetylene welding apparatus to secure all of the advantages of this unique alloy while making use of a minimum amount of it.

THE MANN MASTER CONTROLLER

A new comer in the electric welding field, the Electric Welder Controller Company of Pittsburgh announces their organization, efforts of which are to be directed to the improvement of electric welding.

Their introduction as a new company is necessary, but their personnel needs but very little introduction. The president of the company is Mr. S. W. Mann, of Pittsburgh, who has been actively engaged in the welding field for the last twelve years during which time some of the largest welding repairs in the country have been successfully concluded under his supervision. One of the most noted of his achievements was his originating Precision Welding, the process consisting of welding together broken crank shafts or cylinders or any cast iron or steel section, maintaining throughout the entire operation a degree of accuracy down to the thousandth part of an inch so that no machining would be required to correct alignment. He was also the designer of the Mann Welder. The Mann Master Controller, his newest achievement, is the basis and foundation of this new organization.

The Mann Master Controller

The Mann Master Controller consists of apparatus based on old ideas but so arranged that they produce a new result.

This controller is intended to eliminate some of the difficulties of electric arc welding. From the operator's standpoint it relieves the physical effort necessary in maintaining a correct welding arc under all conditions, especially the conditions that arise in overhead, corner and gap welding. This is accomplished by means of increasing the flexibility of the arc a possible fifteen to thirty per cent depending upon the characters of the arc produced by the machine in question.

From the quality standpoint it is claimed that the device enables the welder to produce a weld cleaner and smoother than has heretofore been possible and in addition to this character it eliminates a large majority of the globules of metal being thrown from the arc to the surrounding plate. It also is effective in preventing pores and pinholes. Just how the above two characters are possible is briefly described by the makers as follows: "The Mann Master Controller eliminates severe arc exploisions. What is meant by arc exploisions is when a globule or drop of metal in its journey from the electrode to the weld momentarily due to its size short circuits the arc. This requires but a fraction of a second and does not mean that the arc goes out but it does mean that the arc circuit is shorted in that one particular part by a mass of molten metal. The severe change in the resistance of the entire electric circuit is so sudden that the current flow rises to such a degree that this drop or globule of metal is actually exploded in the same manner as a fuse would be blown out, scattering the metal in all directions. The controller is so designed that it is impossible to raise or lower the current suddenly. This effort is accomplished by means of a combined choke reactance coil having greater choking qualities than heretofore has ever been employed on a welder. The average reactance coil consists of from fifty to seventy-five turns of copper and laminations of sheet iron running from 150 to 800 as the magnetic return circuit whereas in the coil in the Mann Master Controller consists of 128 turns of copper with a magnetic circuit consisting of upward of 5000 return circuits. It is possible to introduce this coil directly in a 35 volt circuit of constant potential with no resistance whatever in the circuit other than the coil which has a very small drop of only 2 volts at a 300 ampere flow—without at any time having the current rise above 300 amperes.—During the contact of starting the arc or during the holding of the arc at a 25 to 28 volt length. Normally the very closing of such a circuit of a flat compounded 35 volt system would result in a surge of current upward of 800 amperes or in fact to an infinite degree if some protection means were not employed.

"This demonstrates very thoroughly the choking qualities of this coil by the fact that a contact with an electrode can be made and broken to an arc length without having a peak rise in the current flow. The electrode can be held in contact with the work from one-tenth to one-eighth of a second before the current flow exceeds 300 amperes. It is therefore possible that when a globule of metal momentarily short circuits the arc that the current does not rise beyond a normal degree. The time element being sufficient for this drop to continue on it's way into the puddle without going through the combustion process.

"The most valuable feature, however, is that in eliminating the arc explosion as above outlined it also eliminates the pressure accompanying such explosion that exerts its force in all directions forcing the little gas bubbles that are normally boiling out of the weld into the atmosphere, down into the weld where the metal is in a semi-fluid or plastic condition causing pinholes and gas bubbles that have been so undesirable. By eliminating this explosion it eliminates the cause of such gas bubbles or pinholes being present in the finished weld."

Another merit claimed for this controller is its current range which is said to be in excess of any control system now employed, making it possible to decrease the current at will from the very maximum of the welder to as low as ten amperes without decreasing the voltage which is necessary to maintaining a flexible arc. This opens up a new field in the thin sheet metal field and also in the welding of chromium alloys. The improvement of the arc character is also very noticeable in various other alloys and non-ferrous metals, particularly valuable in the welding of copper and bronze. The design of this controller is such that in numerous instances it is possible to eliminate control apparatus consisting of grids and resistance wire and still obtain a more flexible arc through means of the combined choke reactor than is usually possible with the higher voltage, which in brief means that it will decrease the load on the welding generator by decreasing the voltage and raise the current thereby to a value equal in total watts to the higher voltage system which means that it does raise the current capacity of the welder.

Oxy-Acetylene Welding of Copper

Deoxidizers in the Filler Rod Have Not Corrected the Main Difficulties —Experiments Show That Welds Made on Deoxidized Copper Are Better

By S. W. Miller*

NEXT to iron, copper is the most important industrial metal, and its use, both in the pure state and in such alloys as brass and bronze, is very great.

The process of refining copper during its manufacture is of interest as explaining the difficulties in welding it, which have been referred to in welding literature since the early days of the process.

After the preliminary processes that remove the gold, silver, and other valuable elements, as well as the undesirable ones, the copper is further prepared for casting into pigs. As it has a strong affinity for oxygen when molten, the copper becomes saturated with oxygen during the melting, and if cast in this saturated condition, the pigs will be brittle, the center of their top faces will be lower than their edges, and the pigs will have a bad appearance and fracture.

This is overcome by stirring the melted bath with poles made of green wood, the process being called poling. If poled too long, the pigs will rise in the center, and will be porous. When the poling is carried to just the right point, the pigs will have a flat surface neither concave, or convex and will still be free from porosity. Such copper is called "tough pitch." This material, the usual commercial product, still contains a considerable amount of cuprous oxide, Cu_2O, and, due to the presence of this oxide, has a particular property when hot, in that for some distance below its melting point it is brittle and cannot be hammered or rolled, the maximum working temperature being a dull red. This brittleness is a maximum just below the melting point, at which temperature the copper has practically no strength, so that just after the welding operation is completed, if there is any stress at all in or near the weld, cracks appear in either the weld or base metal, and as they cannot be welded, the operation is a failure.

The same general statements are true when either ordinary brazing or bronze-welding of copper is resorted to, though the damage is not so great in these cases. It is very easy to overheat copper in either way, and reduce the resistance of the joint to a point that is dangerous where high strength is needed.

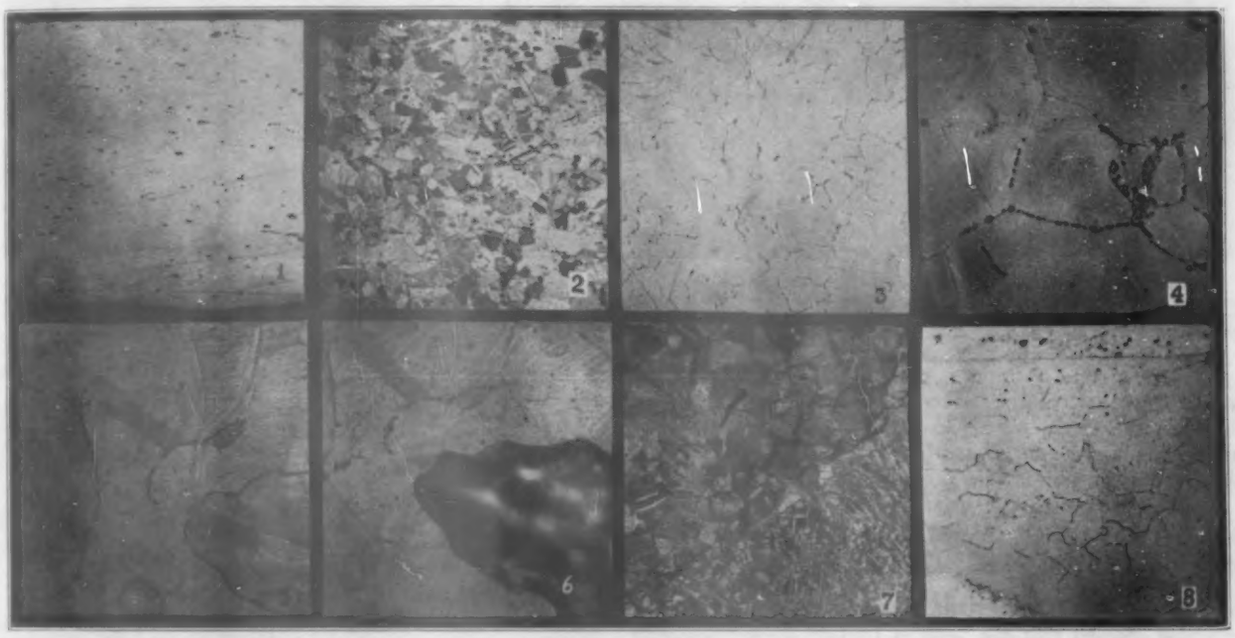


Fig. 1. Average view of the distribution of copper oxide in commercial copper plate. These inclusions are gray blue in color. Unetched. 50X. Neg. 5562. Fig. 2. Average view of the structure of commercial copper plate showing the distributon of the copper oxide. 50X. Neg. 6346. Fig. 3. A general view of the distribution of the copper oxide in the base metal just below the weld metal. It has assumed the apparent outline of the grains. Unetched. 50X. Neg. 5555. Fig. 4. View within the area in Fig. 3 at higher magnification showing that the oxide has formed around the grain boundaries of the copper and, on the right side has joined with the copper to form an eutectic. Etched. 215X. Neg. 5556. Fig. 5. Another view of the oxide at the grain boundaries just beneath the weld. It will be noted that the grain in the southeast corner appears to be outlined completely by this oxide. 215X. Fig. 6. The specimen from which Fig. 5 was obtained was bent slightly. The result was that the grain outlined by the oxide dropped out. This is definite evidence of the lack of strength of the oxide films in the copper. Fig. 7. Commercial copper welded with a bronze welding rod. This specimen was bent while under the microscope. The first ruptures are at the grain boundaries of the copper just under the weld. 215X. Fig. 8. Commercial copper bronze welded. This shows that in bronze welding, the temperature at the surface of the copper is sufficient to cause the copper oxide to be rejected to the grain boundaries as in welded copper. 215X. Neg. 6351.

Much effort has been wasted in trying to correct this trouble by the use of special welding rods containing various deoxidizers. But it has very seldom been recognized that even if the weld metal is clean and strong, the damage is still present just next to the weld in the base metal.

About four years ago the author made a series of tests of copper welding rods containing such deoxidizers as silicon, manganese, aluminum, phosphorus, and various combinations of them. Some of them seemed to work well under the blowpipe and to give sound welds; but rather strangely, when the rupture of a test piece, either by bending or in tension, occurred outside the weld, it was just next to the vee, parallel to its side, and in the case of tensile tests, at practically the same load per sq. in. of base metal, regardless of the composition of the welding rod.

Note: This paper has been read at several local meetings of the American Welding Society.

This showed that the base metal must be defective at the point of rupture, and that the rods had nothing to do with the difficulty.

Of course, it has been common knowledge for years that commercial copper is injured when heated by a reducing flame, but it does not seem to have been realized up to the time of these tests that the trouble with copper welding was due to this cause, the reducing flame of the welding blowpipe being responsible.

The action is really two-fold, as was brought out clearly by a microscopic examination:

1st—The thin melted zone just next to the vee recrystallizes when cooling, and any oxide present collections at the grain boundaries, weakening them and therefore the metal.

Welds were made in this material with the different rods, and much improvement was found. But the best results were not obtained until a welding rod of a composition similar to the base metal was used. Table I shows some of the results obtained under tensile test, and makes clear the superiority of the combination.

As properly deoxidized copper can be forged easily at any temperature, there can be no danger of welding strains cracking it, and as it is just as malleable as commercial material, there is no troube in cold working it.

There is also no difficulty in obtaining it, as any manufacturer will make it if asked to do so.

It is probably true that the complete realization of the possibilities of copper welding will cause an increased demand

Fig. 9. This shows the location of the final fracture in welded commercial copper tested in tension. The failure was within 1/100 inch of the weld line. 65X. Fig. 10. A general view of copper weld metal made with a welding rod containing about 1.0% silicon. The metal is clean and sound. 65X. Neg. 5226. Fig. 11. An average view of copper plate deoxidized with silicon. There are no copper oxide inclusions. Due to the cleaner metal the grains are larger than in the commercial plate. 65X. Neg. 6353.

2nd—Such of this oxide as is exposed to the action of the envelope flame is reduced to copper, which, occupying less space than the oxide, leaves spaces along the grain boundaries, weakening the metal still more.

This reducing action is very rapid, as can be seen by playing the envelope flame across a surface of scaled copper. As soon as the scale has become red hot the surface becomes of the usual copper red color, only a few seconds being needed for the change to occur.

Sections of welds bent slightly and examined under the microscope showed that the path of rupture always followed the visible defects at the grain boundaries.

As the primary cause of the trouble was evidently the cuprous oxide in the metal, some deoxidized copper was made by casting ingots 2 in. square and forging them to the desired size.

Silicon was found to be by far the best deoxidizer, and only a small residual amount of it was found necessary, say from 0.05 to 0.10 per cent. There was no difficulty at all in forging it at a sweating heat—that is, when it was almost melted—and at no temperature below this was there any cracking.

Welds in Commercial Copper

Welding Rod Symbol	*Deoxidizer*	*Tensile Strength Lb. per sq. in.*	*Elongation in 2 in. per cent.*
CSO	Silicon	14,800	6.25
CSI	Silicon	16,450	8.7
MSI	Manganese and Silicon	15,100	7.0
CPI	Phosphorus	14,150	8.7
	Welds in Deoxidized Copper		
CSO		29,450	30.0
CSI		28,800	32.5
MSI		28,650	27.5
CPI		19,600	13.7

Average of a Number of Welds in Each Type of Plate

	Ultimate Strength lb. per sq. in.	*Elongation in 2 in. per cent*
Commercial Plate	15,520	8.1
Deoxidized Plate	26,280	23.0
Original Plate	32,000	—

None of the welds was hammered or heat treated. Such treatments would improve the physical properties.

for welded copper products, which will be of great advantage to industry in many lines.

It should be understood that the presence of oxide can be determined positively by the microscope, or practically by heating a piece of the metal to a bright red and bending or forging it. If it cracks, oxide is indicated, and even if by chance something else causes the cracking, it is not fit for welding and should not be used.

Photomicrographs are given showing the structures and conditions referred to.

The tests referred to were made at the instance of the Union Carbide and Carbon Research Laboratories and the results are published with their permission.

**Union Carbide and Carbon Research Laboratories, Inc.*

C. L. GULICK TAKES EXCLUSIVE AGENCY FOR WHARTON CYLINDERS

Charles L. Gulick, who has been connected with the Wm. Wharton Jr. & Co., Inc., for the past seven years as Manager of Cylinder Sales, made arrangements on April 1st to handle the sales of the Cylinder Department on an exclusive agency basis. It is understood that this arrangement follows the plan that has been adopted by the company for their other products. Mr. Gulick will have his headquarters at 110 East 42nd St., New York City.

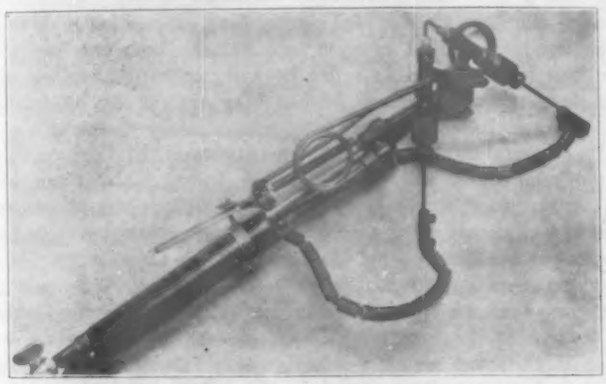
Atomic Hydrogen Arc Welding

Process Developed in Schenectady Research Laboratory Employs Double Tungsten Electrode and a Jet of Hydrogen Gas

TWO methods for producing ductile welds have been developed by research scientists of the General Electric Company, working in different laboratories hundreds of miles apart. Both of the methods, similar in some respects, mark a decided step in the utilization of the heat of electric arcs in the joining of metal parts or the building of metal structures. The one was developed in the Schenectady research laboratory by Dr. Irving Langmuir; the other was developed in the Thomson research laboratory at Lynn, Mass., by Peter Alexander.

In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas. The formation of oxides and nitrides in the weld metal is thus prevented, and the fused metal is as strong and ductile as the original metal.

Announcements of these radically new methods of arc welding are made in the March issue of the General Electric Review. In brief, the method developed by Dr. Langmuir in Schenectady is to pass a stream of hydrogen between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms.



Atomic Hydrogen Arc Welding Torch, Type H

These combine again a short distance in front of the arc into molecules of the gas, and in so doing liberate an enormous amount of heat, so that much higher temperatures can be obtained with this than with the usual welding methods. Since atomic hydrogen is a powerful reducing agent, it reduces any oxdes which might otherwise form on the surface of the metal. Alloys containing chronium, aluminum, silicon or manganese can thus be welded without fluxes and without surface oxidation.

The process developed in the Lynn laboratory by Mr. Alexander is based on the utilization of the chemical and physical properties of hydrogen and other gases in their molecular state. This process aims primarily at the prevention of the formation of the nitrides and oxides in the arc-deposited metal, which limit the ductility of the usual arc welds.

In this process the arc is struck between the metallic wire or carbon used as one electrode and the plate or work to be welded used as another electrode. The crater of the arc is always on the work to be welded. The gaseous atmosphere is supplied in a form of a stream around the arc. Pure hydrogen, water gas, hydrogen-nitrogen mixtures, anhydrous ammonia, methanol vapor and some other suitable gases can be used, according to the nature of the work. The hydrogen-carbon monoxide mixtures were suggested by Professor Elihu Thomson; water gas and methanol are examples of such mixtures.

This process makes the arc welding process more efficient and suitable for the fields which at present are out of its reach. Low carbon steel, alloy steels, and most of the non-ferrous metals and alloys can be welded with success by this process in suitable gaseous mixtures.

Atomic Hydrogen arc Welding, as Developed in the Schenectady Research Laboratory of the General Electric Co.

Fifteen years ago, while studying the loss of heat of the tungsten filaments of incandescent lamps in an atmosphere of hydrogen gas, Dr. Irving Langmuir of the General Electric research laboratory at Schenectady found that at a high temperature the hydrogen gas changed from the molecular to the atomic state. In the molecular state, two atoms of the gas are grouped together as a unit; in the atomic state each atom acts as a unit. The molecular form is the more stable, and when the atoms recombine to form the molecules intense heat is liberated.

Dr. Langmuir's study of the filaments in hydrogen was a theoretical investigation. Now, fifteen years later, the results have been applied in a different field—in the development of a new method of welding, by which it is possible to produce welds as strong and as ductile as the original materials.

Continuing the theoretical investigation, Dr. Langmuir found that more atomic hydrogen was formed by passing powerful electric arcs between tungsten electrodes at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, the atomic hydrogen could be blown out of the arc, forming an intensely hot flame of atomic hydrogen burning to the molecular form and liberating about half again as much heat as does the oxy-hydrogen flame. In this flame molybdenum, one of the most refractory of metals, melts with ease; quartz, however, melts less easily, in spite of its lower melting point. This indicates that the metal assists in the action as a catalyzer—which scientists define as a substance which accelerates a chemical change.

By this method, iron can be welded or melted without contamination by carbon, oxygen or nitrogen. Because of the powerful reducing action of the atomic hydrogen, alloys containing chronium, aluminum, silicon or manganese can be welded without fluxes and without oxidation. The rapidity with which such metals as iron can be melted seems to exceed that in the oxy-acetylene flame, so that the process promises to be particularly valuable for welding.

The technical development of this welding process has been the work of several men in the Schenectady laboratory, including R. A. Weinman and Robert Palmer. These men have developed and tried many types of welding torches, and have tried them under varying conditions. At the same time tests of numerous types of welds have been conducted.

The two electrodes of the torch are tungsten rods, held at an acute angle with each other by lava insulators. When not in use, the electrodes are in contact with each other; they can be separated by pressure on a lever mounted on the handle. A set screw is provided for making slow adjustments of the electrodes. The hydrogen is supplied by a tube through the handle. Sufficient gas is used so that not only are the electrode tips surrounded by enough to form the blast of atomic hydrogen but by an additional quantity to surround the work with hydrogen.

Either alternating or direct current can be used. The first mentioned has been found more convenient, and electrodes of smaller diameter can be used. The gas pressure required to oper-

---

(Note—In the March issue of The Welding Engineer it was intended to publish both of the processes for using a stream of hydrogen in connection with the electric arc for welding. By mistake only the process developed in the Lynn, Massachusetts laboratories was described. The following article describes the work done at the Schenectady laboratory.)

ate the torch is very small; in the laboratory, with short lengths of tubing, a pressure of less than one pound per square inch was sufficient with metals up to one-half inch in thickness. For ordinary welding, the rate of gas consumption varies between 20 and 30 cubic feet per hour.

Since the maximum rate of heating is desired in welding, the torch is held close to the metal. Best results have also been obtained when the torch is inclined so that the blast of hydrogen from the torch passes over the pool of molten metal in a direction opposite to that in which the torch is moved along the line of the weld.

Experiments have been conducted with several gas mixtures and various electrode materials. The best results have usually been obtained with tungsten electrodes and hydrogen alone.

Materials of many kinds have been successfully welded by this

90 Degree Bend in Atomic Hydrogen Arc Weld

method. Low carbon steels up to one-half inch in thickness have been welded without additional material after butting together tightly. Considerable work has also been done in connection with full automatic welding using a butt joint, and with no metal being added to the seam. A number of welds have been made on seamless tubing having a wall thickness of one-quarter inch and an outside diameter of four inches, and with boiler plate iron one inch thick. Welds on deoxidized copper such as silicon-copper have been made up to three-eighths inch thick metal, giving unusually good sections.

In testing welds made by this process, the welded portions have been twisted and bent double without cracking or otherwise being injured. Such a procedure has not been possible with the ordinary arc weld, since such welds are usually brittle because of the presence of nitrides or a thin film of oxide or scale, removed in the new process by the presence of hydrogen.

E. F. HOLINGER OFFERS CONSULTING SERVICE

It has been learned that Mr. E. F. Holinger has severed his connection with the M. W. Kellogg Company of Jersey City, N. J., in order to devote his time and attention to consulting engineering work. Mr. Holinger is widely known in the seamless steel cylinder field in the United States, having been formerly connected with the Seamless Department of the National Tube Company and also with the Tindel Morris Company, and while with the M. W. Kellogg Company had the direction of the manufacture of the large ton containers used during the war for the shipment of chlorine and other gases. Mr. Holinger's consulting work is especially in connection with seamless steel products of all kinds and hydraulic forgings. Mr. Holinger is associated with Charles L. Gulick at 110 East 42nd St., New York City.

U. S. WELDING AND HARRIS CALORIFIC COMPANIES CONSOLIDATE

The announcement has been received of the consolidation of the U. S. Welding Company, Minneapolis, Minnesota, with the Harris Calorific Company, of Cleveland, Ohio. The former is moving its plant and general offices from Minneapolis to Cleveland, so that communications for the U. S. Welding Company should be addressed to the Harris Calorific Company, U. S. Welding Division, 2828 Washington Avenue, Cleveland, Ohio. Mr. John Harris, who has been identified with the oxy-acetylene welding and cutting industry almost from its very beginnings, announces that he is retiring from active business. Mr. George B. Harris will be the new president and Mr. Lorn Campbell, Jr., will be appointed vice-president and general manager.

It is reported that production will be continued on both lines of welding and cutting apparatus which have previously been marketed by both of these companies.

To many of the old timers in the oxy-acetylene industry it would seem like a good many years since Mr. John Harris reported his first experiment with high pressure gas flames. Throughout this time he has continued to experiment with the process; not only in developing a complete line of apparatus but also in determining some of the other uses for high temperature flames and the efficiency of various kinds of fuel gases for use in the torch. The apparatus made in this factory has had a wide distribution and continues to enjoy good patronage from the trade. Mr. Harris' long association with this industry is such that even though he may have the best intentions in the world to retire he will not entirely relinquish the deep personal interest he has taken in the oxy-acetylene process and its applications.

It is certain, also, that the management of the consolidated companies will be in capable hands. Mr. Campbell has contributed a great deal to the industry in addition to making a success of the organization and development of his enterprise in Minneapolis. During the war he made two important contributions to the industry. One of these was a complete text book on oxy-acetylene welding, which continues to be one of the best sellers, and another was the organization of an army welding school where hundreds of welders were trained for military service. Since that time he has given his attention to the management of the U. S. Welding Company and to the improvement of its products, which include welding and cutting torches, regulators and acetylene generators. The consolidation is partly a result of the need of this company for increased manufacturing facilities. Mr. Campbell states that he expects to be able to greatly improve the production schedule just as soon as the work of installing his equipment in the new location has been completed. Incidentally, Mr. Campbell made the trip from Minneapolis to Cleveland in an automobile, right at the time when the section of the country through which he passed was enjoying a series of rainstorms and blizzards. That would probably make a good story by itself which would be interesting to cross-country motor enthusiasts. When last seen he was trying to make South Bend, Ind., before dark and was still confident that he would finally be able to go into Cleveland on his own power.

HELMET FOR ACETYLENE WELDERS

The Chicago Eye Shield Company, of Chicago, manufacturers of welding goggles, helmets and face shields, have developed a special form of protection for acetylene welders who are obliged to wear glasses. For these men the Chicago firm recommends a helmet somewhat similar to the helmets worn by arc welders. This provides a window of protective glass which shields the eyes from the intense glare of the welding operation, at the same time holding it far enough away from the face so that there is no discomfort caused by the additional use of corrective glasses.

Welding Wire Specifications

Only a Small Number of Specifications Have So Far Been Accepted as Standard—Are Not a Greater Number of Standards Needed?

By F. E. Burk*

THE writer has often wondered why no authority on the subject of welding wire manufacture or development has ever brought to general notice the small number of welding wire specifications which thus far have been accepted as standard. This article is written on the supposition that they have been narrowed down in an effort to standardize. It may be possible that the few that are accepted as standard, are the only ones thus far recognized, but the writer's remarks apply in either case. If the latter situation prevails, it is an argument in favor of further research work, to the end that by further diversification sufficient specifications may be developed to fit any welding problem.

There is no question but what standardization in general has proved a wonderful thing for American industry. Fostered by our capable Secretary of Commerce, his call for the elimination of useless specifications in all branches of industry has met with hearty response, resulting in incalculable saving in American industry.

Are Not More Standards Needed?

But, in the manufacture of welding wire, is there not a limit to the minimum number of specifications that can be expected to cover all classes of work? It is true, of course, that in plants where only expert welders are employed and no extraordinary problems are presented, satisfactory results can be secured in most cases with the few grades of wire now considered as standard. The extraordinary skill of a great number of welders can, to some extent, be expected to overcome the handicaps presented, if they are capable of handling a large number of welding problems with a very few grades of wire.

But in view of the fact that thousands of problems are submitted to the welding industry, should not the trend be towards diversification of welding wire specifications, in order that the maximum number of problems may be met?

Rank and File Welders Need Carefully Selected Wire

The welding process is gradually being employed in an innumerable number of industries. In thousands of cases, possibly only one unit is used, and at that only part time with the welder doubling in some other capacity. The welder working under such conditions has absolutely no chance to secure experience with all kinds of working problems, training under skillful welding foreman, and the actual practice with the welding machine, that all the around welding expert can secure. Can the rank and file of welders, in this class, hope to reach the highest state of efficiency, when required to handle a wide range of welding problems, with the limited number of specifications recognized as standard?

In one case he may be called upon to make a high tensile strength weld, 80,000 lbs. or even higher. Another case presents a problem where maximum ductility is required. In a third case the requirements may be easy machining qualities in the weld, a fourth high abrasive qualities, a fifth non-porosity. There may be any number of combinations of these requirements and there are many more, too numerous to mention, each of which to be met, must be handled with a specially prepared wire, developed to meet each particular problem.

Importance of Competitive Conditions

There are many other phases of the situation. Take the shop that is working on a very close competitive basis. There are many such, where the welder is required to work at the highest possible speed. There are many cases where there is a large percentage of overhead work but only one analysis can be used on the job. Can the welder accomplish satisfactory results and at the same time be limited in the choice of welding wire specifications?

Then there is a wide range of analyses in the parent metal, and what is more important, a wide range of quality in analyses both in the physical structure, particularly of steel, and as regards the presence of too much impurity such as phosphorus and sulphur. If we are going to make an exact science of welding can we overlook the physical and chemical variations of the parent metal?

I have not yet mentioned the human element. There we have a vitally important factor in welding efficiency that can never be standardized. Thousands of welders are recruited from the ranks of employees without regard to their special fitness for the work either from the standpoint of physical manipulation or the technical knowledge of machines and welds required.

Make Wire to Fit Each Case

Why not take all these problems into consideration in the manufacture of welding wire? The proper attention to the physical and chemical details will develop a solution to each problem. By observing the proper shading in analyses, annealing, coatings and other factors, wires can be offered to fit each case.

The highest tensile strength can be developed, the weld can be made extremely ductile, easily machined, nonporous, resistant to abrasion. These requirements may be combined and many other properties may be developed,

Your high speed welder will have a wire specially developed to absorb or resist the intense heat generated, your overhead welder will use another specification of the same analysis for this part of his work, your less experienced welder in arc welding will use a wire especially intended to help him maintain his arc without breaking it or freezing, your welder in poor quality parent metal will use a wire designed to give him the proper balance of elements in the weld.

Care Used in Selecting Parent Metal

Let us look at the problem from another point of view. In the selection of welding rods your welder is limited to a very small selection of rods, not more than two at the outside. The weld he makes is a casting, a very poor substitute, at best for the refined structure of the parent metal. On the other hand the greatest attention has been paid to the manufacture of the metal to be welded. In steel, for instance, a wide variety of analyses have been developed to meet every problem. The metal is hot rolled, cold rolled, cold drawn, forged, cast or made by some other refining process to improve its structure. Special attention is paid to annealing and normalizing. Every possible attention is given to make it suitable. Millions have been spent in research work to bring each grade to its present state of perfection.

Since we are handicapped by the fact that we cannot duplicate the physical or chemical structure of the parent metal in the weld, why should not the same attention to detail, the same diversifications in specifications be carried through to the manufacture of welding wire, to the end that the attributes of the parent metal may, as nearly as possible, be preserved in the weld.

(*Continued on page* 36)

**General Manager, Central Steel & Wire Co., Chicago.*

Buying a Spot Welder

What Information the Customer Should Supply in Order to Get a Machine Best Suited to His Work

AFTER a spot welder is installed the purchaser may proceed to operate it on the theory that the human element has been entirely eliminated and that consequently a uniform quality of welds can be expected from it, regardless of who the operator is. The experiences of many users indicate clearly enough that it is not a case that no matter how carefully such a machine is constructed there are certain operating principles to be observed and a certain amount of supervision necessary to secure maximum efficiency in its operation. It is true, however, that the operation of spot welding equipment is tremendously simplified by the fact that it is constructed for specialized operations and that the instructions for proper operations need in no case be complicated or difficult to understand. The operation is, therefore, a popular one for production work and the ability of the apparatus to produce a very satisfactory profit is due in no small measure to the fact that the problems involved in welding particular jobs are solved in the factory where the equipment is manufactured, thus reducing the operator's responsibility to a minimum.

There are a number of factors which control the result you may expect to get from spot welding and the user's chances of getting maximum satisfaction will be greatly increased if he sees to it that all of these factors are taken into account in the selection of his machine. He may be very much impressed by the performance of apparatus which he has seen in another factory and might make a serious mistake in ordering an exact duplicate of it for his own work. It is therefore necessary to give the manufacturer the greatest possible amount of information regarding the work to be done so that the equipment can be made to suit the work. One manufacturer of spot welders, the American Electric Fusion Corporation, of Chicago, makes an effort to secure all possible information on the first inquiry, so as to reduce the amount of uncertainty in estimating the customer's requirements. An interview with Mr. E. J. Henke, president of this concern, brings out some of the information which he thinks the company needs to have in advance from each customer.

The most important consideration is of course the material to be welded and the shape in which this material comes. There is practically no combination of shapes which cannot be handled by special devices. Sheets, wire, stampings, rods and forgings can be welded to similar shapes or to different shapes, but in the design of the equipment it is absolutely necessary to know what the proposed assembly is and what the dimensions of each piece are because this will effect both the design of the electrodes and the heating capacity of the transformer.

Dimensions are to be given in sufficient detail to show whether the pieces welded together are of the same size or of unequal sizes. In the latter case it is often necessary to do considerable experimenting with actual work in the factory in order to be sure that the machine is properly tuned to the job. There is so much difference between the welding qualities of different materials and even different materials which are commonly classed in a single group, that the manufacturer is obliged to call for a careful description of the metal itself; the words iron and steel do not tell him the whole story; he must know whether the iron is cold rolled or hot rolled; if the iron is galvanized, he must know this in order to make provision for not destroying too much of the zinc coating. In the case of steels the carbon content will naturally make a considerable difference because a process which gives perfectly satisfactory welds in steel of low carbon content would produce welds in high carbon steel so brittle as to require annealing.

It is also necessary to make allowance for the differences in the hard and soft brasses and the different bronzes, and the difference between pure nickel, monel metal and German silver; each of these different materials is affected in different ways by being raised to a fusing temperature and subsequently cooled. The manufacturer of spot welding equipment has necessarily made a careful study of these various conditions and, knowing in advance that they are going to be encountered in the welding operation, is able to provide for that in the construction of the machine. This construction problem is complicated when different metal are welded to each other, but research work has provided records of the solution of many of these problems so that it is often a matter of routine to give the customer the benefit of knowledge which has been acquired at considerable cost.

Authorities on the subject of resistance welding invariably recommend that stock be as clean as possible, but in practice it is found that the pieces to be welded are brought to the machines in varying degrees of cleanliness. Where other methods of assembly have been used no difficulty may have been experienced in handling materials which are more or less dirty, oily or covered with scale. The manufacturer of your spot welder, however, wants to know whether you intend to provide for work on clean, bright metal and if not what condition the metal will be in when it is welded. If a weld that is absolutely clean and free from slag inclusions is desired, the metal must be clean, and if the maximum life is desired from the welding electrodes, the metal must be clean; dirty stock is very hard on the electrode tips and if dirty stock is going to be welded, the electrode tips must be made to stand this extra service.

Another important consideration is the amount of finishing which is to be done on the welded pieces. In some cases all finishing is done afterward. Whether this is to be in the form of electro-plating, painting, enameling or galvanized, determines the care which has to be made in executing the weld. Some factories require finishing processes which make it absolutely necessary that the surface of the weld be left undisturbed, that is, with no indentation. The electrodes have to be very carefully designed to meet these exacting requirements and the operation of the machine itself has to be worked out with particular accuracy.

The electrodes used in spot welding are an interesting study. In some plants the work calls for the simplest construction and a casual glance would indicate that these pieces of equipment need not be very expensive to replace or to keep in repair; in fact, a good many of them are of the home-made variety and kept in working order by occasional applications of the file, but this isn't the way to get the best kind of results from the electrodes. In most cases these electrodes are designed for specific operations and the slight difference between them have a very important effect on the result. Some operations are more severe upon the electrodes than others and if these operations are carried on on a large scale, that is, if the welder is doing continuous duty every day, it is essential to design the electrodes with a view to keeping them in continuous service as long as possible so as to reduce the operating time lost while changing or repairing the electrodes when they become so used up that they no longer perform efficiently.

To the prospective purchaser of spot welding equipment the subject of price is naturally an important consideration. A large investment in machinery must be justified by marked advantages in operation. It is not a difficult matter though to assume roughly whether or not machinery of this kind should be purchased, assuming that a small welder can be purchased for $500.00 and that it can be expected to last at least ten years. Deduct a six per cent interest charge on the investment and a ten per cent depreciation charge, giving sixteen per cent, we find that the total which the machine has to earn is sixteen per cent of $500.00 or $80.00 per year. In other words, this type of machine would pay for itself if it could effect a saving of less than $0.00 per month. The cost of spot welding is so much less than the cost of riveting on a great

many sheet products that it is not a difficult matter for a spot welder to show this saving where there is anything like a reasonable amount of production demanded from it.

There is another item in the list of subjects which the buyer has to cover in acquainting the manufacturer with his requirements. That is the nature of the power supply. It has an important bearing on the cost of spot welding machinery. Where alternating current is available there is no additional cost involved, but if the available power supply is direct current it is necessary to add a rotary converter to the equipment in order to furnish alternating current to the welder. The cost of a converter will usually be in the neighborhood of seventy-five per cent of the cost of the spot welding machine itself. There is, of course, a small loss of power involved in using the rotary, so the cost of operation of the equipment will be slightly increased.

These are the details which are to be taken into account when planning to join metal parts by the spot welding process. The equipment itself is only considered a good investment when there is plenty of work for it to do. The return from the investment is safeguarded by making sure that the entire equipment has been so carefully designed that it will give the best results on the special work for which it is purchased. This design is in the hands of the manufacturer, who is invariably anxious to please. All the information he can secure before preparing a machine for shipment will be helpful to him in making the machine deliver a satisfactory volume of good welds.

McCUNE TALKS TO CHICAGO SECTION ABOUT WIRE

At the regular monthly meeting of the American Welding Society, Chicago Section, held Friday evening April 2nd, Mr. C. A. McCune, director of research, American Chain Company, Bridgeport, Connecticut, read a paper on the subject of wire and its uses. This paper was followed by the showing of several reels of motion pictures which illustrated the manufacture of steel and subsequent operations which are necessary for the production of wire. Some of the pictures showed important uses of steel wire outside of the welding industry. Particular interest was shown in the pictures of the construction of a suspension bridge. Every detail of the fabrication of the huge cables was illustrated by the pictures. Some more pictures were shown of wire fence used on highways to keep automobiles from going off the road. Mr. McCune gave a fine talk on the characteristics of welding wire, showing the difference between wire which is specially processed, for welding and wire which has been made for other purposes with the same chemical analysis and also described and illustrated a few tests of the quality of welding wire. This meeting occurred at the time of month when weather conditions were most unfavorable but nevertheless the attendance was good and the long discussion which followed the presentation of the paper and pictures indicated a lively interest on the subject.

MAKING COPPER GASKETS

Commenting on the recent article on this subject, a contributor to *The Welding Engineer* states that he has been making gaskets for locomotives for some time and that he gave up the idea of brazing them, after the first trial. His experience was that the brazed joint did not anneal and become pliable as the copper base. He changed the joint from a braze to a weld, using a copper filler rod from stock, using 1/8 inch copper wire for 3/16 inch and 1/4 inch gaskets. His experience was that a good weld with copper, on copper gaskets, made a better and more pliable joint than brazing. It can be annealed with no danger of melting the joint. In dome jackets the gaskets may be used several times and annealed each time used, when the joint is welded, whereas the brazed joint is more liable to cause trouble on account of having been heated too many times.

DEATH OF ALEXANDER BLASER

Alexander Blaser, a welding and cutting expert with the Air Reduction Sales Company, died at his home in Union City, N. J., March 24, after a long illness, aged forty-one years. Mr. Blaser was born in Switzerland, and came to the United States at the age of twelve with his parents, who settled in St. Louis, Mo. He learned the coppersmith's trade, and in the practice of his trade went to Jersey City where he was employed by the Davis-Bournonville Company in 1910. The Davis-Bournonville Company was then actively developing and promoting the oxyacetylene welding and cutting processes, and Mr. Blaser's mechanical ability and ingenuity found scope in this congenial work. He became an expert torch operator of unusual ability, particularly on the Airco-Davis-Bournonville oxyacetylene, cutting machines, and a well-known figure at convention exhibits at which these machines were demonstrated. He excelled in cutting tool steel dies and similar work requiring heat treatment before and after cutting. Mr. Blaser was a past officer of the Knights of Pythias and a member of Eagle Lodge No. 53 F. and A. M. A delegation from the Eagle Lodge conducted the Masonic commitment service, after which the body was cremated. He is survived by Mrs. Blaser and two sons.

INTERNATIONAL OXYGEN COMPANY TO PRODUCE KNOWLES ELECTROLITIC CELLS

Mr. A. A. Heller, general manager of the International Oxygen Company, Newark, N. J., has just returned from a lengthy stay abroad in the course of which he concluded an arrangement with the International Electrolitic Plant Company, Ltd., England, makers of the Knowles Electrolitic Plants to operate under their patents in the United States and Canada. The Knowles cell is said to be an advanced type of electrolitic generator from the point of view of both first cost and operating efficiency. It is particularly recommended for installation where large quantities of hydrogen are required. Oil hardening plants and plants for the production of synthetic ammonia in Europe, South Africa, China and Japan are using the cell for the production of hydrogen. The International Oxygen Company is planning to produce this cell in this country to meet the large hydrogen demand which they feel certain will develop in America in the near future.

FILM SHOWS STRUCTURAL STEEL WELDING

A film has been prepared for the Lincoln Electric Company of Cleveland showing the use of welding in structural work. Contents of this film are based on the actual construction of the Peerless Auto Sales Company of Canton, Ohio, the first all welded building to be erected in the United States.

Engineering details showing the special designs as worked out for the application of welding in place of riveting, scenes of the welding equipment in operation and complete pictures of the corresponding work being done by a crew of riveters make up this educational feature.

The owners have arranged to allow Technical Societies, engineering schools, Chambers of Commerce and like groups exhibit the film to their members without charge except express costs. Several copies of the film have been made so that more than one organization may view the picture at the same date. Groups desiring to exhibit this film can arrange a date for its use through the John B. Abell Organiztion, 637 Union Trust Building, Cleveland, Ohio.

A BOOKLET ON GAS WELDED BONDS

The Ohio Brass Company, Mansfield, Ohio, manufacturers of the well known O. B. Signal Bonds, have prepared in booklet form the article entitled "Gas Welded Bonds on the

Erie," by C. A. Nichols, Signal Supervisor of the Erie Railroad, which appeared in Railway Signaling last month. This article makes a neat little eight page booklet containing four illustrations of the Erie bonding installation. An interesting feature of the booklet is a table which gives a summary of the cost of installation of over 17,000 welded bonds.

ARC WELDED GAS HOLDER

What s believed to be the first all arc welded gas holder built in this country was constructed during 1925 at Lexington, Missouri, by the Western Gas Construction Company of Fort Wayne, Ind. This holder has a capacity of 15,000 cubic feet of gas.

An Arc Welded 15,000 Cubic Foot Gas Holder.

Six weeks were required to build the holder. General Electric welding equipment was used and two welders and three mechanics did the work. Bottom plates and the two upper courses

Gas Holder Arc Welded Bottom Completed—First Side Course Being Welded.

of sides plates are 3/16 inches thick, the first side course is ¼-inch plate and the container and crown are of No. 10 gauge material.

All seams are lap welded Bottom and side seams are ¼-inch laps, the bottom seams being welded with a continuous fillet on one side while the side seams have a continuous fillet on one side and tack welds on the other. The side seams of the container are welded on both sides with a continuous weld. Seams on the crown are welded on one side only.

STOODY ANNOUNCES NEW GRINDER

The Stoody Company, of Whittier, California, is marketing a new type of flexible shaft grinder which they say is so designed as to be readily applicable to many unusual grinding operations. It will operate on either 220 volts or 440 volts. The net weight of the complete equipment is 155 pounds. The grinder is operated by a one horse power motor and is equipped with a seven foot flexible shaft with double housing. The construction is such that the shaft and wheel are comparatively light, allowing user to adjust the pressure for either heavy duty or careful finishing work. At the same time it is constructed strongly enough to be suitable for heavy, continuous grinding, polishing or buffing service. It is equipped with twenty-five feet of cable with the motor mounted on a strong steel frame truck.

NEW WIRE HAS GREEN SURFACE

The Chicago Steel & Wire Company, Chicago, Illinois, manufacturers of gas and electric welding wire have announced a new type of arc welding electrode which they designate as "Green Surface." In developing this wire the company states that they have taken into account the effect of surface materials on arc stability. They therefore worked out a method of putting a special surface on all of their different grades of electric welding wire so that each grade of wire can be obtained with this particular surface. It is not, therefore, sold as a flux coated wire and is not intended to replace flux coated wire for a number of the special uses to which fluxed wire is particularly well adapted. Manufacturers point out that it is an intermediate step between what is commonly known as bare wire and flux coated wire.

WELDING WIRE SPECIFICATIONS

(Continued from Page 33)

Let Welding Experts Prescribe

The whole situation may be summed up as follows. The particular welding problem may be likened to a disease or illness. The welding engineer, welding wire expert of whoever is called upon to suggest the proper filler rod is the physician. The welding rod recommended is the prescription. You can no more expect your welding expert to recommend one or two grades of wire that will fit every welding problem than you can expect your physician to recommend one universal Peruna that will cure every disease the human body is heir to.

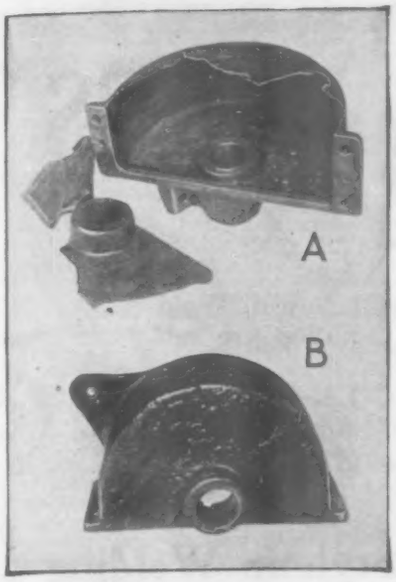
OXO-GRAMS—A NEW HOUSE ORGAN

Oxo-Grams is the name of a house organ which has just been issued by the Bettendorf Oxygen-Hydrogen Company, Bettendorf, Iowa. This is an interesting little folder printed on a single sheet. It contains two columns of humor and good natured comment, with little suggestions here and there which are of interest to the users of oxygen. "We may occasionally talk a little about business," says the editor in the first number, "but only when we have something which we know you will be glad to learn."

NEWS OF THE WELDING TRADE

On April 7th Mr. G. E. Harcke of the Air Reduction Sales Company gave a demonstration of liquid oxygen and a talk on the oxy-acetylene process accompanied by motion pictures, at the meeting of the Hartford, Connecticut, Section of the A. S. M. E.

Mr. Howard Russell, Vice-President of the Spokane Oxy-Acetylene Company, was a recent visitor in Chicago. Mr. Russell is doing a brisk business in the Spokane territory in oxygen,



TOBIN BRONZE

REG. U.S. PAT. OFF.

for Difficult Cast Iron Welding Jobs

THE cast iron gear case "A," broken in three parts, offers a problem known to experienced welders. Ordinary welding methods would require a high fusion heat for such a job, and the resulting shrinkage of the casting would tend to pull the bearing holes out of alignment and make the casting worthless.

The repair, as actually made with Tobin Bronze by the oxy-acetylene process, is shown in "B." It was accomplished easily and quickly at a low red heat, without extensive pre-heating. Shrinkage was avoided, the parts were held in perfect alignment, and the weld was stronger than the original cast iron.

The cracked casing of the steam pump shown in "C" could hardly have been repaired so economically by any other means than Tobin Bronze Welding. The repair was made at a low red heat and the pump was restored to service promptly, in as good condition as ever, at a substantial saving in time and expense.

The speed and accuracy made possible by the elimination of extensive pre-heating make Tobin Bronze Welding the logical method for many production operations as well as for repairs.

Tobin Bronze Welding Rods are made solely by The American Brass Company and "TOBIN BRONZE" is stamped in the metal.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

TOBIN BRONZE

REG. U.S. PAT. OFF.

WELDING RODS

"RACO" WELDING WIRES

America's Standard

All "Raco" Welding Wires are guaranteed to meet the American Welding Society specifications in every particular, and in addition are subject to rejection from any cause whatsoever.
The well established policy of THE REID-AVERY CO. to specialize in welding wire only insures absolute satisfaction to our customers. Lowest prices consistent with unvarying quality, prompt attention to orders, unlimited guarantee.

RED LABEL (Iron) - - for Oxy-Acetylene Welding
BLUE LABEL (Mild Steel) - - for Electric Welding
HIGH CARBON, for both Arc and Acetylene Welding

THE REID-AVERY CO., Inc.
21st and Washington Ave., Philadelphia, Pa.

acetylene and welding equipment, and his visit in Chicago was a part of an extended trip which he has made through the middle west to get acquainted with the conditions of the industry in this section.

Collier weekly publishes a picture of Mrs. Catherine Nelson of Jersey City, New Jersey, announcing that she averages $30.00 a day as an electric arc welder.

Mr. L. F. Loutrel, Vice-President and General Manager of the Shawinigan Products Company, and Mr. R. A. Witherspoon, Vice-President and General Manager of the Canada Carbide Company, have just completed a visit to the Shawinigan plants at Keokuk, Iowa, and Anniston, Alabama, where both plants are operating to full capacity.

H. R. Pennington of the C. H. Hollup Corporation, Chicago, has been seriously ill and is now receiving hospital treatment. It is reported that Mr. Pennington will undoubtedly be able to resume his duties within a few weeks.

Mr. J. E. Styrmoe, who has recently been connected with the service department of the Westinghouse Electric Manufacturing Company, recently resigned to accept a position with the Central Steel and Wire Company, Chicago.

The Hoxite Company, Stamford, Connecticut, manufacturer of Hoxite flux, have sent out notice that they are soliciting dealer accounts for the distribution of their product.

The International Oxygen Company announces the appointment of Mr. Charles Kandel as Sales Manager of the company. Mr. Kandel is an old timer in the oxygen industry and is well known to the trade, both as an engineer and salesman.

Henry Booth, Sales Manager of the Shawinigan Products Corporation, sailed from New York, April 3rd, with his mother and sister for a six weeks' pleasure trip in England and Scotland.

CURRENT WELDING LITERATURE

STRAND FLEXIBLE SHAFTS AND EQUIPMENTS—Twenty-four page booklet printed in two colors, describes and illustrates a number of different types of flexible shaft drilling, grinding and buffing machines. Data on the subject of wire cores, metal casings, rotary files, attachments, wheels and accessories are also included.—Published by N. A. Strand & Company, 5001 North Lincoln Street, Chicago.

THE ARC WELDING OF SEAMS IN STEEL PLATES, by J. T. Carr—Paper read before the Institution of Welding Engineers, at Leeds. Preprint of this paper reviewed above.—The Welding Journal, London, March.

TESTING THE SKILL OF WELDERS—Illustrations of methods used for determining the efficiency of welding operators in plants where different kinds of work are done, with discussions of the individual tests.—The Welding Journal, London, March.

REPAIRING OIL SATURATED CRANK CASES—A practical discussion of the difficulty of repairing old oil soaked crank cases with the torch and suggestions for overcoming difficulties caused by the presence of oil in the pores of metal.—The Welding Journal, London, March.

OXY-ACETYLENE TIPS.—Monthly publication of the Linde Air Products Company, New York. The April issue features an article describing the applications of oxy-acetylene welding for both repair work and construction work in gas plants. Another article describes the welding operation on a two-ton punch press which saved approximately $2,300.00. A timely suggestion for production welding is contained in an article on welded radio towers. An article on regulators gives a number of valuable suggestions for maintaining the efficiency of the equipment. Following this, another good one giving in detail the procedure for making both rolling joints and fixed joints in steel pipe.

ARC WELDED HYDROGEN AND OTHER GASES, by P. Alexander—Description of apparatus and procedure used in the Thompson Research Laboratory at Lynn, Mass. in making welds with the metallic arc surrounded by atmospheres of hydrogen and other gases. The advantages claimed for the process are increased speed and increasd ductility in the weld deposit.—Journal A. W. S., March.

FUSION WELDED PRESSURE VESSELS, by S. W. Miller—A criticism of the present code of the A. S. M. E. for the construction of unfired pressure vessels of certain needs for revision in this code are pointed out and a new code covering this sort of construction is proposed.—Acetylene Journal, April.

SOLDERING, BRAZING AND RIVETING SHEET METAL, by A. Eyles—Soldering alumimum successfully requires that the inside film be first removed from the surface. In the case of brazing it is desirable to have the fusion point of the filler material as close as possible to that of the metal to be joined. It is usually more satisfactory to purchase brazing materials, however, to make them. But the use for which they are to be put should always be specified so that the proper alloy may be secured. Pure borax is a satisfactory flux for brazing sheet metals.—American Machinist, March 25th.

ESTIMATING FABRICATED PIPE COSTS, by I. A. Butcher—Methods by which it is possible for an engineer to estimate or check costs for most power plant piping. Comparative costs of headers when extra heavy cast steel fittings are used and when welded nozzles are used.—Power, March 16th.

CUTTING STEEL PIPE TO WELD ELLS, TEES, CROSSES AND BRANCHES—Directions and diagrams for cutting steel pipe so as to make good joints in the different designs which are incounted in the construction of various kinds of pipe lines.—Acetylene Journal, April.

RELATIONS BETWEEN THE TEMPERATURES, PRESSURE AND DENSITIES OF GASES—Circular of the bureau of standards No. 279 obtainable at 25c per copy from the Superintendent of Documents, Government printing office, Washington, D. C. The purpose of the circular is to show in a simple manner as possible the methods by which these relations may be computed and to present the necessary experimental data in such a way that this can be directly and easily used for solving practical problems. The charts and tables of particular interest to manufacturers of compressed gases including oxygen, hydrogen and nitrogen.

ACETYLENE WELDING AND INVENTIONS, by C. Hollard—A discussion of the fundamental inventions which are led to the development of the oxy-acetylene process followed by suggestions for possible improvement in the application of the process which might result from future inventions providing apparatus and methods are a greatly different character. Revue De La Soudure Autogene, Paris, February.

THE CORROSION WELDS IN STEEL SHEETS, by R. Grangon—A short study of the reason why welded containers become corroded in the vicinity of the weld. It is indicated that the rolling of ingots which have impurities in their centers result in the production of sheets along a thin zone of impurities in the center, like meat in a sandwich. The author states that the welding process distributes these impurities along the line of fusion so that they are readily attacked by corrosive elements, whereas the steel sheets which do not have these impurities in the center are not so subject to corrosion after having been welded.—Revue De La Soudure Autogene, Paris, February.

ELECTRIC WELDED CONSTRUCTION, by James Colwell—Preprint of a paper presented before the Institute of Welding Engineers of London. The author discussed different tests which have been made to determine the suitability of arc welding for structural steel construction and gives lists and descriptions of actual welded structures which indicate the suitability of the welding process for this class of work.

THE ARC WELDING SEAMS IN STEEL PLATES, by J. T. Carr—Preprint of a paper presented before the Institute of Welding Engineers of London following a brief historical treatment of the development of the welding processes. The author talks about the subject of the metallic arc process and its applicability to steel plate construction. Different types of joint designs are compared, and there is a short discussion of the factors which govern the speed of the welding.

EYEOSEE INTERNATIONAL CUTTING AND WELDING EQUIPMET—12 page bulletin just issued by the International Oxygen Company, Newark, N. J., describes and illustrates a complete line of Oxy-Acetylene welding and cutting apparatus including parts and supplies. There is a wide range of sizes of welding and cutting torches and gas pressure regulators. The EYEOSEE high pressure valve is strongly featured. Included in the bulletin is a price list of outfits, individual units and welding supplies.

THE METALLURGY OF AN ELECTRIC ARC WELD IN MILD STEEL, by A. G. Bessill—A study of an electric arc weld deposit showing the structual changes in mild steel plate which result from the deposit of a one layer weld. This is supplemented by photographs showing the affects of poor operation on the structure of the weld metal.—Journal of A. W. S., March.

METALLURGY OF WELDS, by Geo. A. Ellinger—A discussion of the chemical content and the structure of steel and the affect of welding upon them.—Journal of the A. W. S., March.

RECLAIMING LOCOMOTIVE MAIN RODS, by Joseph Murphy—Description of the method used in reclaiming locomotive main rods in which the holes have become so large that the rods are too weak for further service.—Journal of the A. W. S., March.

OXY-ACETYLENE WELDING OF COPPER, by S. W. Miller—An investigation of the cause of failures in copper welds showing that best results are obtained by using the deoxidized copper for the apparent metal.—Journal of the A. W. S., March.

ATOMIC HYDROGEN ARC WELDING, by R. A. Weinman and Irving Langmuir—Description of the experiments made in the Research Laboratory of The General Electric Co. at Schenectady, New York. A stream of hydrogen directed into an arc between tongston electrodes is made to produce a flame of atomic hydrogen which is even higher temperature than the oxy-acetylene flame. Experiments have been made in the use of this flame for welding various metals.—Journal of the A. W. S., March.

Salesman Wanted—An old-established company, manufacturing and selling compressed gases, apparatus and supplies, is interested in obtaining the services of several experienced salesmen. Excellent opportunity for men of ability to advance. No applicant will be considered unless full information concerning his past experience is submitted. Address 88, care The Welding Engineer.

Wanted—Salesmen handling complete line of welding supplies to sell welding rods and wire, both gas and electric—for large manufacturer, on commisson basis. Apply—The Seneca Wire and Mfg. Co., Fostoria, Ohio.

For Sale—A number of service right on Prest-O-Lite cylinders. Real bargain. Price on request. Address Oxygen Syracuse Company, Syracuse, New York.

Position Wanted—By welder with 10 years' experience; can handle any kind of acetylene or electric arc work. Can engineer work in either line. Obtained experience in best shopes in country. Will go anywhere. Address 89, care The Welding Engineer.

Manufacturers of electric or oxy-acetylene welding equipment desiring an agency in Philadelphia write E. J. M., 2314 East Mercer Street, Philadelphia, Pa.

Kerr's Training Course

in Practical Welding

A Standard to go by—

An Instruction Course for ***completely training or improving*** **the man who uses the torch, and for the Company that wants better welding from its welders.**

There is a separate lesson for each type of job in Welding, Cutting, and Brazing, with full Explanation, Illustration, and Instruction in exactly what to do—Why it is done—How to do it—and what each job should look and be like. All metals covered.

If you do welding this Course is a Standard by which to judge your ability, your welds, cuts, and brazes. If you employ welders, it is a standard by which to judge the ability of the men you hire.

Master Welder's Diploma

Issued to each Graduate—

Graduation requirements: Examination average 80% or better; and test welds which we send you.

Satisfaction Guaranteed

or Tuition Refunded

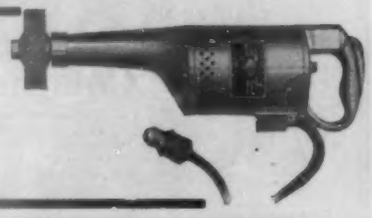
For particulars and a free sample lesson **write at once** giving name, address, and place of employment. State your welding experience, and if you have the use of a welding outfit. (No obligation involved.)

Kerr's Welding School

Box 1313, Dept. 3, Los Angeles, Calif.

Standardize on Finished Workmanship!

It isn't enough simply to make good welds. You should make it standard practice to give every job a neatly finished appearance. You can do it at low cost with the light, smooth-running WODACK Portable Electric Grinder. Leading welders use it and are satisfied. "Electric Tool Facts" tells why. Send for a copy.



Wodack Electric Tool Corporation

43 S. JEFFERSON ST. CHICAGO, ILL.

PAGE-ARMCO
PROCESSED

Welding Wire and Electrodes

assure perfect welding *on* structural steel

Wherever structural steel must be welded quickly and economically — Page-Armco Welding Wire and Electrodes will prove their superiority. The exclusive Page method of processing all wires and electrodes to meet the type of welding for which they will be used assures against spoiled work—saves the welder's time and shows a reduction in costs.

Whatever your welding problems, you can permanently and economically solve them by adopting as standard Page Mild Steel Gas Welding Wire and Electrodes or Page-Armco Wire and Electrodes and Page High Carbon Wire and Electrodes.

Let us prove this to you. Write for data and samples for tests. No obligation.

Page Steel and Wire Company

An Associate Company of the American Chain Co., Inc.
Bridgeport, Connecticut
District Offices: Chicago, New York, Pittsburgh, San Francisco

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	125 cu. ft. cap.
12x36-in. size	225 cu. ft. cap.
12x44-in. size	275 cu. ft. cap.

Commercial Acetylene Supply Company, Inc.

General Office: 80 Broadway
New York City

BRANCHES:

80 E. Jackson Blvd.
Chicago, Ill.

683 Atlantic Ave.
Boston, Mass.

613 Trust Co. of Georgia Bldg.
Atlanta, Ga.

417 Market Street
San Francisco, Calif.

Wellsworth 464 Welding Goggle

Safety at a low cost

Efficient, safe and comfortable, this goggle meets the demand for a welder's goggle at a popular price. The well ventilated black fibre eye caps are shaped to fit the contour of the face.

Genuine Saniweld Lenses offer adequate protection from harmful Infra-Red and Ultra-Violet rays.

The clear glass cover lenses are separated from the welding lenses by fibre rings to make the goggles cooler and more comfortable. A spring eye wire permits the replacing of lenses quickly and easily.

American Optical Company

Factories at Southbridge, Mass.

NEW YORK, 70 West 40th St. SAN FRANCISCO CHICAGO, 10 So. Wabash Ave.,
ST. LOUIS KANSAS CITY ATLANTA

SWEDOX

WELDING RODS, WIRES and ELECTRODES

SEND FOR TESTING SAMPLE

We want every welder in the country—big or small—to be convinced of the ***specialized superiorities*** of SWEDOX products. We know that a trial ***will*** convince you. Hence the free offer. Try SWEDOX on your next welding job at our expense.

No matter what the job is, there is a SWEDOX product especially made for it. We sought and obtained from the nation's expert metallurgists and welding engineers the best analysis for each task. Science has put into SWEDOX rods and wire the proven betterments that make them the recognized standards in every case.

You'll find SWEDOX products free from impurities, uniform in analysis and therefore economical because their use reduces the cost of application and of machining.

We'll send you a sample, at our expense, enough for a thorough test—one which should prove to you, as thousands of welders know, that SWEDOX products are the standards.

SWEDOX booklet describing the products and their uses in detail, will gladly be sent upon request. Address department 4.

CHICAGO, ILL.
4545 S. Western Blvd.
Lafayette 8500

Central Steel & Wire Company

DETROIT, MICH.
5001 Bellevue Ave.
Lincoln 6780

Roebling Welding Wire

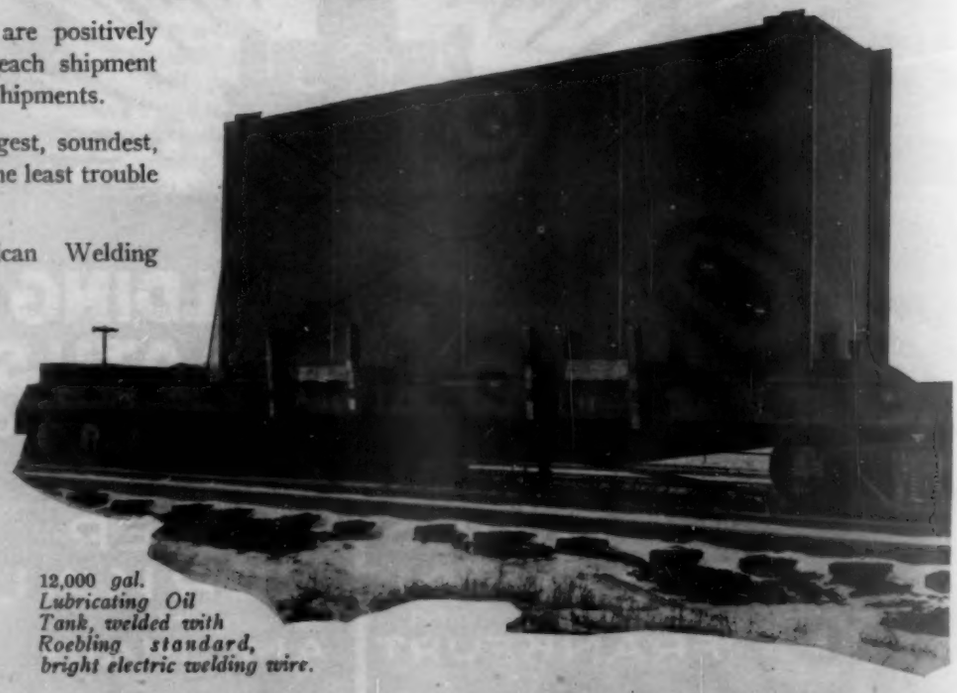
Strong—Tough—Durable

Roebling Electrodes are positively uniform throughout each shipment and throughout all shipments.

They make the strongest, soundest, toughest welds with the least trouble in welding.

Conform to American Welding Society specifications.

John A. Roebling's Sons Company, Trenton, N. J., Makers of Wire Rope and Wire



12,000 gal. Lubricating Oil Tank, welded with Roebling standard, bright electric welding wire.

"WELDMACO"
MANGANESE WELDING ELECTRODES

Has your experience in Manganese Welding been of the hit and miss variety? After hours of painstaking work with sputtering arc have your raised your hood with a sigh and said "well done?" Or have you guessed that the job was "well done" when you knew that the big possibility was there that you may have been merely burning up high priced steel? Would relief from this guess-work be worth investigating?

There IS something new under the sun—"WELDMACO"—and it makes a deposit of 12% to 13% Manganese, free of Blow-Holes, Craters and Cracks. It flows as easily as a low carbon rod and gives deep penetration without damage to the steel structure of the work-piece.

The Price? 35c Per Pound at New Orleans.

WELDING MATERIALS COMPANY
1113 NEW ORLEANS BANK BLDG., NEW ORLEANS

Manufacturers of Manganese Welding Electrodes ONLY

A Good Proposition Open for Dealers Everywhere

WHARTON
Standard Seamless Steel Cylinders

for—

OXYGEN
HYDROGEN
LIQUEFIED PETROLEUM GAS

Interstate Commerce Commission Specifications

WILLIAM WHARTON JR. & CO., Inc.
EASTON, PENNA.

Positive Protection against Hand Hazards

Protexrite Asbestos Gloves give positive protection to hands that work around furnaces, cupolas, open hearths and at welding operations. Prevent nasty burns—help to insure full time work. Made of 90% pure Canadian asbestos, long fibred. Carefully designed, sturdily constructed. Supplied in styles to meet all needs. Write for samples and prices.

The Safety Equipment Service Co.
BUELL W. NUTT, President
1228 St. Clair Ave., Cleveland, Ohio
"Safety Service"
PROTEXRITE GLOVES

OXECO ACETYLENE CYLINDERS

THERE are two important elements in acetylene cylinder construction, namely, the shell and the porous filler.

The Oxeco truly seamless shell is made entirely from one piece of carefully selected steel. Every step in its manufacture is under complete control. Wall thickness and strength are accurately predetermined for every part of this type shell. At no point is its strength an unknown quantity.

Monolithic filler is accepted by leading acetylene companies as being the perfect porous material for use in acetylene cylinders. This type filler performs its safety function throughout years of service and abuse because its strength and structure positively prevent any distintegration or sagging.

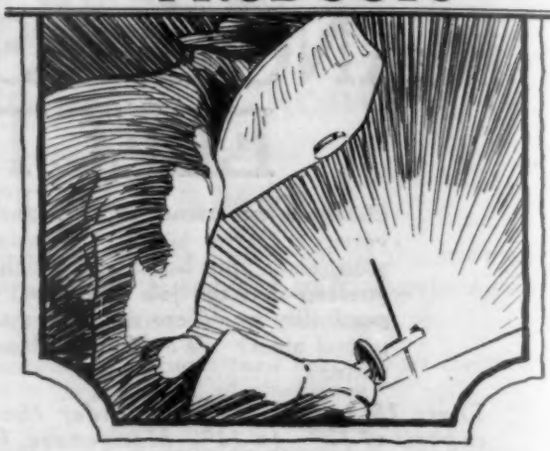
Such cylinders are invariably filled in strictly modern plants where no expense has been spared in order to insure the fact that only the highest quality acetylene is produced.

Specify ***"delivered in seamless monolithic filled cylinders"*** on your acetylene purchase orders.

KEITH DUNHAM COMPANY

110 South Dearborn Street
CHICAGO, ILL.

WICKWIRE SPENCER *PRODUCTS*



Intelligent Economy

The cost of a welding rod is but a small percentage of the value of your time on a job. Yet its quality determines the quality of your work.

From mine to warehouse every process of manufacturing Wickwire Spencer Wissco Welding Wire has been conducted by us with scrupulous care. Our welding wire is free from oxides, dissolved gases and other impurities. It insures smooth welds.

It is sufficiently liquid under heat to avoid piling, but its even flow prevents covering unfused materials. Care should be taken to order the proper grade of Wickwire Spencer Wissco Welding Wire.

Our leaflet will assist you in this or your dealer can properly advise you.

WICKWIRE SPENCER STEEL COMPANY
41 East Forty Second Street
New York

Dixon's Graphite Rods and Plates for Welding

Made in all diameters, lengths and sizes.

Small diameter rods are sold in 4, 6 and 8 inch lengths, the shorter the rod the less breakage in shipping.

Also Dixon's Graphite Welding Putty. In 5 and 10 lb. cans.

Dept. 202A.

Joseph Dixon Crucible Co.
JERSEY CITY, N. J.
Established 1827

Welding Applied to Your Job

Modern Welding has long passed the stage when just any welding machine and any welding process will do.

The nature of the work to be welded, the capacity of the welding machine, the use of the carbon arc or metal arc, the properties of the weld metal are vital factors in the speed and efficiency of your welding.

We are interested in your most difficult Welding Problem.

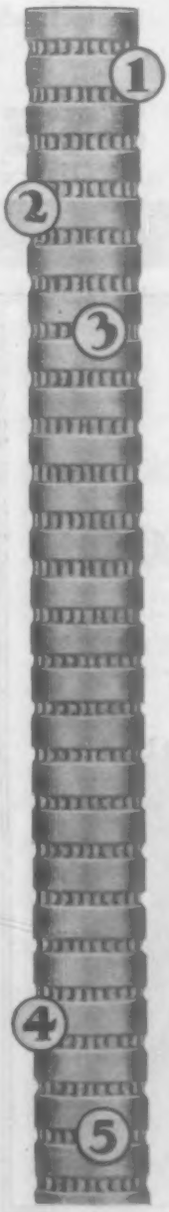
THE UNA WELDING & BONDING CO., Cleveland, Ohio

Welding Processes
Welding Rods

UNA PRODUCTS

A.C.—D.C. Welders
Welding Supplies

a new and *better* WELDING WIRE



The welding industry continues to progress. Daily you hear of new uses, new methods, new equipment, and now a new and better welding wire—the KORO coated electrode, corrugated.

Its outstanding superiorities are:

One—Corrugation—the rod is corrugated at regular intervals before the coating is applied. These corrugations set up crystalization zones which vary the resistance, causing the desirable cupping action at the arc.

Two—Uniformity—metal can be supplied for practically any type of work and subsequent runs are held strictly to required specification.

Three—Coating—this high-temperature-resisting mineral substance is applied under great pressure. It's free from silicon, is a conductor of electricity (no bare spot required) and resists rough handling, will not flake off. In action the Koro coating stays on right down to the arc; ordinary coatings fuse faster, melt away from the end, giving the effect of bare wire.

Four—Speed—Koro rods work best at reduced amperage, proving their claim to unusual penetration and speed.

Five—Arc Action—the Koro coating stays on right down to the arc, deoxidizes the atmosphere around the weld; the corrugations produce a current lag; the metal in the rod is pure—as a result of all the factors, a larger and straighter arc can be maintained. Less spattering of metal, less eye strain.

Will you give us an opportunity to prove these claims, either by placing a small trial order or allowing us to demonstrate in your shop?

KORO

ELECTRIC CORPORATION
229 W. ILLINOIS ST.,
CHICAGO, ILLINOIS

Weldite

Welding Rod

GREEN SURFACED ELECTRODES

A product of our Research Laboratories which standardizes the working qualities of all types of Electrodes in the Weldite Line. These electrodes are especially surfaced but not flux coated. They produce an arc so stable that they can be used on alternating current as well as direct. The price is the same as the ordinary bare electrode.

CHICAGO STEEL & WIRE Co
103rd Street *and* Torrence Avenue CHICAGO

Gas SEACO TRADE MARK **Arc**

Welding Rods

If you are not already a user of Seaco Rods, try a small quantity and compare the quality with the rod you were using.

Samples on Request

"It isn't only the analysis that counts!"

STULZ-SICKLES CO.
IRON & STEEL PRODUCTS

125 LAFAYETTE ST.,
NEWARK, N. J.

—AND THE PRICE IS $14.40 PER DOZ.

The Willson Welding Goggle No. L70 is not built down to a price, but just low-priced.

Built of good fibre and shaped for comfort; well ventilated, edged with sweat-proof padding, and furnished with genuine curved Industre Glass protected by clear cover glass.

WILLSON GOGGLES, Inc.
Manufacturers of goggles, respirators and welding helmets
READING, PA.

Welding Rods—

Seneca Brand

Gas Weld and Electro Weld Rods

For Various Requirements

GRADE NO. 1. For Electric Welding, a low carbon soft wire with a smooth soft action in the arc.

GRADE NO. 2. For Electric Welding—meets the American Welding Society specification E No. 1B.

GRADE NO. 3. Acetylene Welding—a low carbon smooth rod suitable for all general repair shop use.

GRADE NO. 4. Acetylene Welding—the purest iron stock and meets the American Welding Society specification G No. 1A.

All Grades supplied in accordance with customer's requirements.

Highest quality guaranteed.

Your Inquiries Will Receive Prompt Attention

The Seneca Wire Mfg. Co.

Established 1905

FOSTORIA OHIO

Do You Figure Labor

in your welding costs?

Labor is the biggest factor in the cost of arc welding. Based on a labor rate of 75c per hour, the labor cost per minute is 1¼c, approximately the difference between the cost of bare and coated electrodes. Two minutes saved in an hour's work will pay this difference. Therefore the electrode which permits faster work and reduces the labor cost is the most economical.

WANAMAKER
COATED ELECTRODES

Increase the speed of welding

Send in a sample order and see what savings you can make.

C. H. HOLLUP CORPORATION
3333 W. 48th PLACE—CHICAGO, ILL.

ACETYLENE WELDING SHIELDS

Our No. 11 Shield, especially for welders who wear correction glasses. You will enjoy the comfort and freedom afforded by it.

This shield is fitted with "ESSENTIALITE" Welding Glass—The glass you will like. Price, $4.00 each, f.o.b. Chicago, Ill.
Sold by all dealers in welding materials, and manufactured by:
CHICAGO EYE SHIELD COMPANY
2300 Warren Ave., Chicago, Ill.

IDEAL
FACE SHIELDS

Ideal Face Shields protect the head, chest and neck against direct and reflected rays. Easily adjusted and removed. Constructed of vulcanized fibre and aluminum, assuring durability and lightness. Hinged door allows quick inspection of work or interchange of glasses.

IDEAL WELDING GLOVE

The Ideal Glove for Electric and Acetylene Welders is made from Sheep Skin, which has been Subjected to an Asbestos Treatment and which makes it both heat resisting and fireproof.

IDEAL WELDING APRON

The Ideal Apron for Welders is made of leather which has been especially treated to stand the heat, and at the same time be very flexible and durable.

THE IDEAL FACE SHIELD CO.
468 N. Garfield Ave.,
COLUMBUS, OHIO

E. F. Holinger

CONSULTING ENGINEER

Associated with
Chas. L. Gulick

110 East Forty-Second Street
New York City

You Can Do It Better With TORCHWELD

Consistent Performance of Torchweld Non-Flash Cutting Torches Insure Low Cutting Costs.

Records kept of tests in steel foundry cutting show costs of 4 mills to 4½ mills per square inch,—an outside variation of but one-half mill per square inch of cutting.

Torchweld Non-Flash Cutting Torches are made in two styles, i. e., with tips of either one piece or two piece tip construction to meet every operating or production requirement.

Send for Catalog 23E

TORCHWELD EQUIPMENT COMPANY

224 NO. CARPENTER STREET **CHICAGO, ILLINOIS**

THE
ALMANC
METALLIC
ELECTRODE HOLDER

Most Simple—Most Efficient—Metallic Electrode Holder Yet Developed.

There are no springs to lose tension for the grip is positive through both jaws. Careful construction has reduced heating to a minimum, while the operator is at the same time fully protected from shocks. It is simple to quickly insert and release the electrodes, which can be used with very small amount of waste. Its construction permits the removal or replacement of the holder cable with only the aid of a screw driver—it is not necessary to use soldering. All of these exclusive features make the Almanc Metallic Electrode Holder a wise buy.

Distributors Wanted

ALLAN MANUFACTURING AND WELDING CO.
726 Washington St., Buffalo, N. Y.
Welding Equipment Welding Accessories

K-G TORCHES
REGULATORS
COMPLETE UNITS

K-G WELDING AND CUTTING CO., Inc.

Home Office and Factory: 556 W. 34th St., New York City

DISTRIBUTORS & SERVICE STATIONS:—

J. G. Brown, 255 Ninth Street, San Francisco, Calif.
Chicago Grinding & Machine Co., 2117 Tilden St., Chicago, Ill.
Motor Accessories Company, 1041 Hamilton St., Allentown, Pa.
Harry P. Winslow, 15 Vinton St., Worcester, Mass.
Wisconsin Motor Parts Co., 2354 Cottage Grove Ave., Chicago, Ill.
Welders Supply Co., 700 McCulloh St., Baltimore, Md.
J. W. Evans Sons, 95 Brook Street, Tompkinsville, S. I.
Albany Welding & Boiler Works, 40 Madison Ave., Albany, N. Y.
H. Harrison Kress, 1718 Sansom Street, Phila., Pa.
Gaul, Derr & Shearer, 16th & Fairmount Ave., Phila., Pa.
Welding & Supplies Co., 3445 Parthenais St., Montreal, Can.
Welding & Supplies Co., Toronto, Can.
Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich.
A. G. Sprague, 870 Amboy Avenue, Perth Amboy, N. J.
Sight Feed Generator Co., West Alexandria, Ohio.
Welders Service Co., 5031 Liberty Ave., Pittsburgh, Pa.
Passaic-Bergen Welding Works, 650 Main Ave., Clifton, N. J.
Passaic-Bergen Welding Works, 356 Fair St., Paterson, N. J.
Sutton-Garten Co., 425 North Capitol Ave., Indianapolis, Ind.
The Oxygen-Syracuse Company, 601 East Washington St., Syracuse, N. Y.
Storrs Welding Co., Meriden, Conn.

DEPENDABLE APPARATUS FOR ALL CASES
DEALERS
OUR PRICE WILL INTEREST YOU

SUPERFLUX
FOR ALL OXY-ACETYLENE WELDING

Here is the flux you have been waiting for. It keeps the metal surface clean, does not swell, and permits welding without hardening the parts welded.

IT IS THE SUPERFLUX FOR WELDING

Price $2.00 { Cast Iron—Cast Steel—Copper / Mild Steel — Brass — Bronze } Per Pound

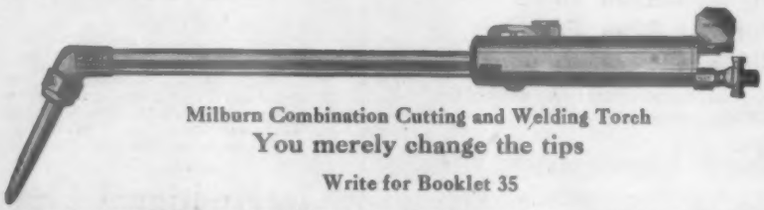
Made by the makers of the Famous Laffite Welding Plates and Tempering Powder.

A full line of Welding Rods in stock at all times

THE PHILLIPS-LAFFITTE COMPANY

Incorporated 1906
1005 PENNSYLVANIA BLDG. PHILADELPHIA, PA.

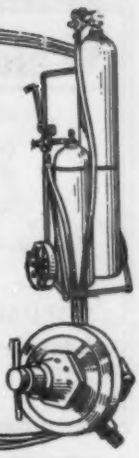
WELDING AND CUTTING TORCHES,
REGULATORS, GENERATORS and PREHEATERS



Milburn Combination Cutting and Welding Torch
You merely change the tips

Write for Booklet 35

THE ALEXANDER MILBURN COMPANY 1416-28 W. BALTIMORE ST. BALTIMORE, MARYLAND



If you dig into facts you will find

lives up to its slogan "More Gas per Pound"—

SHAWINIGAN PRODUCTS CORPORATION · NEW YORK · Plants · Shawinigan Falls, Quebec, · Keokuk, Iowa.

IMPERIAL WELDING AND CUTTING EQUIPMENT
OXY-ACETYLENE PROCESS

New Mixing Principle

a regulator that accurately controls gases, the greatest working range ever covered by ONE torch—are exclusive IMPERIAL features.

WRITE FOR CATALOG

IMPERIAL BRASS MFG. CO.
517 S. Racine Ave. Chicago, Ill.

American Welding Society
33 West 39th Street
New York, N. Y.

WHAT IS IT DOING?

WHO ARE ITS MEMBERS?

The Secretary has a copy of the Membership Directory for you. Write for it.

Eye Protection

Goggles
Helmets
Hand Shields
Spectacles

WE MAKE
all styles to meet
all requirements
of *all* safety codes
Write for catalog

Guaranteed Comfort-Strength-Protection Economy

STRAUSS & BUEGELEISEN
30 Front Street - BROOKLYN, N. Y.

Welding Carbon Products

National Round Welding Carbons
National Welding Carbon Plates
National Welding Carbon Paste
National Welding Carbon Flour

Our welding carbon products are designed especially for welding operations

National Carbon Company, Inc.
Cleveland, Ohio San Francisco, Cal.
Canadian National Carbon Co., Limited
Factory and Offices: Toronto, Ontario

I.O.C. SYSTEM
INDUSTRIAL GASES
OXYGEN HYDROGEN
ACETYLENE NITROGEN

Quick shipment and low prices. Also cylinders, valves, Eyosee and International welding and cutting torches, regulators, welding wire, cast iron and aluminum rods, fluxes, plain and armored rubber hose, asbestos pads and paper, goggles, etc. All equipment fully guaranteed. Write for catalog and prices.

American Pioneer Manufacturers of Oxygen.

International Oxygen Company
Main Offices: NEWARK, N. J.
Branch Offices: New York, Pittsburgh, Toledo.

LIQUEFACTION PLANTS
for the Production of
OXYGEN–NITROGEN
Furnished In Any Capacity from 70 Cubic Feet Per Hour Upwards.

HEYLANDT SALES COMPANY
OTTO ADAMS, General Manager
140 South Dearborn Street, Chicago

QUASI-ARC SYSTEM

Manufacturer of:
A. C. & D. C. Welding Sets
Dealer in Weldtrodes:
Mild Steel
High Carbon
Manganese
Cast Iron
L-W. 110 V. WELDER
Gives Machinable Weld

H. E. STEINBOCK
Peekskill, New York

THE accuracy of measurement achieved by the U. S. GAUGE is not the result of chance—it is the product of scientific design and skilled craftsmanship in manufacture.

U. S. GAUGE CO.
44 Beaver St., New York
Pressure and Vacuum Gauges
All sizes and types for every purpose

ARC WELDER DISTRIBUTORS WANTED
We desire distributors to sell and supervise the sale of USL electric arc welding equipment. Unusual money making opportunity for men who are qualified and familiar with arc welding and its applications. A worthwhile connection. Further particulars upon request. Write Department M.

U. S. LIGHT & HEAT CORPORATION
Niagara Falls, N. Y.

REBUILT LINCOLN WELDERS
6-200 amp. motor drive 3 phase 60 cycle on trucks.
2-300 amp. motor drive 3 phase 60 cycle.
3-200 amp. motor drive D. C. 220 volts.
Our stock list shows 40 more arc welders, spot welders and butt welders.

GOODMAN ELECTRIC MACHINERY CO., 126 Green St., Newark, N. J.

DRILL–GRIND–POLISH
STRAND
FLEXIBLE SHAFT EQUIPMENTS
Several Sizes
N. A. STRAND & CO.
5001 N. Lincoln St. CHICAGO

Prest-O-Lite

SERVICE RIGHTS
on
Prest-O-Lite Welding Cylinders
BOUGHT AND SOLD
ALFRED E. CORP
40 Mathewson St. Providence, R. I.

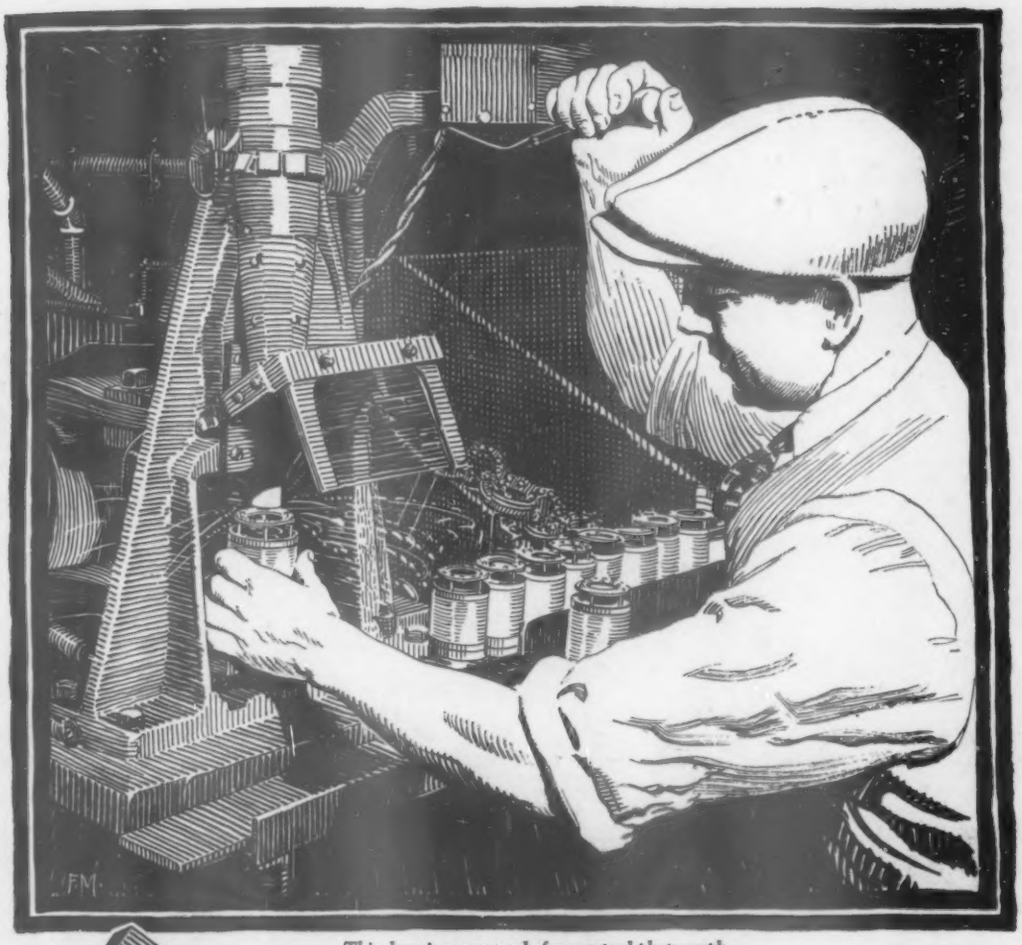
WELDING ROD HOLDERS
For the Oxy Acetylene Welder.
Price $1.00

ALL STEEL WIRE BRUSHES
45c Each, 3 for $1.00

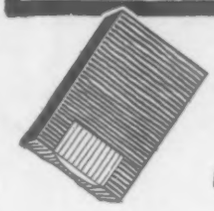
Write for Dealers' Prices
C. SORENSEN, 18 E. 16th ST., CHICAGO, ILL.

WELDING SUPPLY DEALERS
Do your customers know how best to use the apparatus you sell them? The best way you can serve them in this respect is to furnish them The Welding Engineer, and The Welding Encyclopedia. Write for our plan.

The Welding Engineer Dealers Service Dept.
605 S. Dearborn St., CHICAGO



This drawing was made from actual photograph



FACTS TALK No. 1*

THIS machine is one of a battery of 14 at the plant of one of the largest low price automobile companies which weld roller bearing assemblies 16 hours per day.

ELKONITE

was substituted for their standard welding electrodes because:

Their standard electrodes required changing and dressing every 28 minutes.

Elkonite Welding Electrodes serve without change or attention 166 to 224 hours.

Elkonite Welding Electrodes of special tungsten alloys give remarkable service, where hard drawn copper fails in pressure resistance welding (spot, butt, ridge, lap, etc). They maintain a practically constant Brinnell Hardness under all service conditions whereas hard drawn copper drops from 90 to about 40 in use.

They have made spot welding of brass commercially possible.

If you have a special problem in pressure resistance welding the facilities of Elkon Laboratories are at your disposal in determining the suitability of Elkonite.

ELKON WORKS Inc.
Subsidiary of P. R. Mallory & Co. Inc.
Weehawken, N. J.

Exclusive licensee under General Electric Co.'s patents dated May 26, 1925, Sept. 1, 1925. Other patents pending.

Here are views of a 42 in. x 62 in. cast iron low pressure engine cylinder before and after taking a 48-hour dose of "ALTERNARC" cast iron distemper treatment.

Portable
Durable
Flexible

Yes—You can weld cast iron with the "ALTERNARC" system

WITH an "Alternarc" you can weld cast iron, steel, malleable iron, copper, bronze, lead, stainless steel and monel metal. The range of work you weld in place without preheating, and without dismantling is easily shown when you see the "Alternarc" used for boiler work, cracked water jackets, furnace sections, crank cases, rear ends, scored cylinders and battery work. The cylinder job illustrated shows the possibilities.

Our "Alternarc" Machine can be "Universal," so that they will operate on any industrial power supply. M-G sets are also built for any voltage, phase or frequency, depending on your particular requirements. A gas engine Dualarc generator set giving both A-C and D-C is supplied as a complete power house with air compressor if desired.

Electric Arc Cutting & Welding Co.
152-158 Jelliff Avenue
Newark, N. J.
U. S. A.

This "ALTERNARC" machine delivered the current 48 hours, and made the engine as good as new.

"ALTERNARC"

CUTTING *and* WELDING